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ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Combination Bolt Cutting Machine.

With this is illustrated a new bolt cutter recently brought out by the Bridgeport Machine Tool Works, of Bridgeport, Conn. N. Y. Office, 72 Warren St.

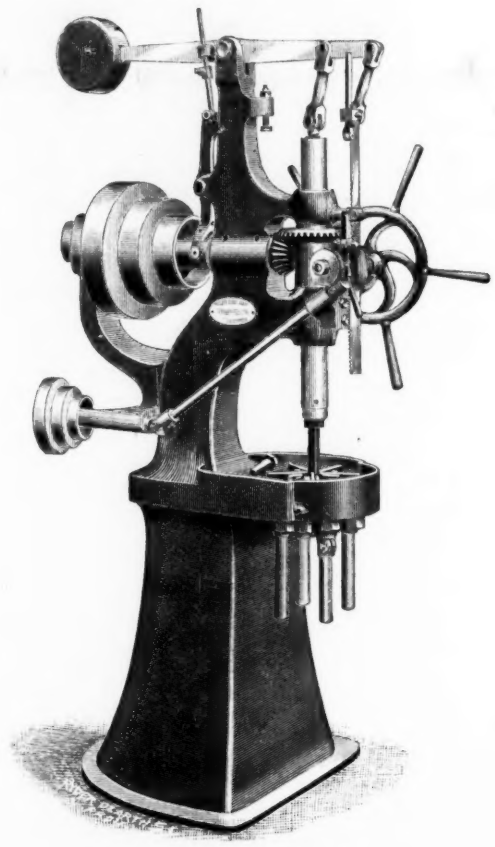
It is so arranged as to cut turned bolts, holding them upon centers, the same as is done in the lathe.

As will be seen by reference to the cut, the machine is provided with a tail-block of the same construction as is used upon lathes, and which can be clamped in any desired position upon a carriage which slides to and from the head. This carriage has also mounted upon it the necessary devices for preventing the rotation of the bolt while being acted upon by the dies. Projecting from its sides are two arms, the ends of which are bored to fit the bars, one of which is seen extending along each side of the machine. The other ends of these bars are fixed to a cross-bar shown outside the driving gears. Into a boss in the center of this cross-bar is fitted a shaft, which is also fitted to, and slides through the spindle. At its other end it carries the center, the point of which is seen projecting from the head, and between which and the tail-stock center the bolts to be cut are held.

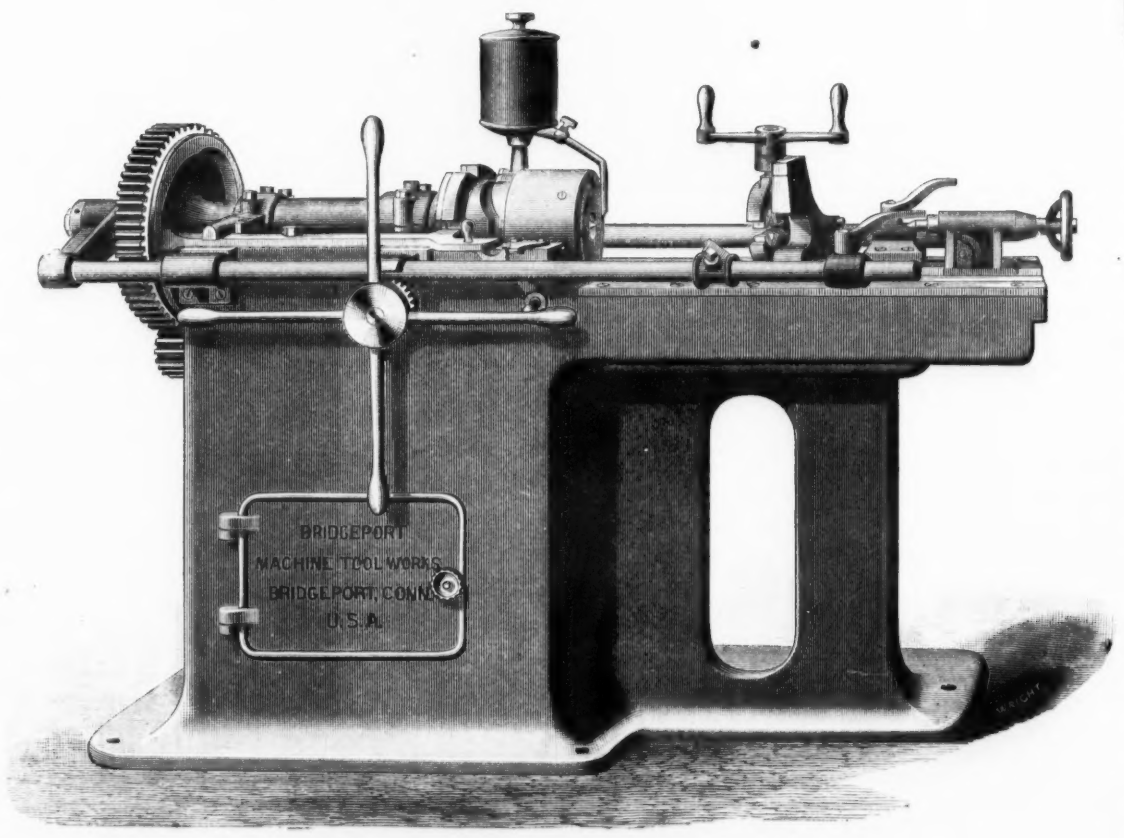
The arms which project from the sliding carriage can be clamped fast to the bars by the clamp screws shown, and when this is done a rigid, rectangular frame is formed, its sides being composed of the round bars, while the ends consist of the sliding carriage at one end and the cross-bar at the other. On the under side of the bar which is in front, rack teeth are cut, and thus by means of the pinion and "pilot-wheel" shown, this frame with the bolt to be cut may be moved lengthwise of the machine by the operator. Immediately back of the head, and fitted to the spindle, is seen a cam, the position of which determines the opening and closing of the dies. This cam turns with the spindle, except when prevented by the engagement of a trip lever with one of the four notches cut in the collar, two of these notches showing in the cut. The lever which engages them is shown in front of and parallel with the main spindle. At one end it is provided with the upwardly projecting small handle shown, while the other end runs back to a point at which it may be acted upon by a cam formed inside the large gear wheel. Now a bolt having been turned and placed between the centers, it is moved up by the operator until it is engaged by the die, after which it feeds itself to the desired point, the same as the ordinary bolt cutter. Upon the bar having the rack-teeth is shown a collar which may be clamped in any desired position, and which, when the thread is cut on the bolt to the desired length, trips a suitable mechanism and releases the lever, which by a spring is moved inwards until it engages with one of the notches upon the cam, holding it from rotation and thus opening the dies. The operator now, by means of the rack and pinion movement, draws the bolt out of the die; the lever continues to hold the cam until it closes the die again, and at the right time the cam, formed in the large gear wheel, forces the lever out of the notch, allowing the cam to again revolve with the spindle, this action taking place at a time when the cam is in the position in which the die is closed.

When the lever is drawn out of engagement with the cam, the small lever shown below it drops into place by the action of gravity, and prevents a re-engagement of the large lever with the cam until again released, either by the collar as before or by the hand of the operator.

The cone pulley for driving is inside the bed of the machine directly under the spindle. The machine will cut bolts from ½" to 1½" diameter. Extreme distance between centers, 32 inches. When desired the centers may readily be thrown out of position, and the machine is then ready for cutting common or rough bolts of any length, and up to 1½" diameter. Six changes of speed are provided for, and with each machine is furnished nine sets of dies with corresponding taps, and hobs for re-cutting dies.



ROD AND BOLT TURNING MACHINE.



COMBINATION BOLT CUTTING MACHINE.

New Rod and Bolt Turning Machine.

The object of this machine is to produce more uniform work, especially with bolts, and at a much lower price than by methods usually employed.

All the cutters consist of simple pieces of bar steel ground and tempered, and the resharpening is done by grinding the ends. In detail, the machine consists of a firm base, as shown, which can be extended when so desired, to support several machines. On top of this is secured the frame which holds the main shaft, at one end of which is the cone pulley; beyond this is a smaller feed pulley used to drive the feed motion pulley below. At the other end of the main shaft are a pair of bevel gears, which transmit the motion to the upright spindle. This spindle is made to travel up or down by the hand wheel shown or automatically from the feed motion, as indicated above. To the top of the spindle is attached a lever, pivoted at the top of the frame, and having an adjustable counterpoise weight at its further end, used to assist the feed motion by balancing the weight of the spindle. The cone pulleys run loosely upon the shaft, upon which a keyed clutch is placed, and which, when thrown in or out, causes the shaft to revolve or stop, and this without the necessity of shipping the belt. Attached to this clutch is a series of lever motions, the last of which is fastened to the top lever, and which is so arranged that when the spindle is at its highest point, the clutch is thrown out and the spindle stopped, thus enabling the operator to, with much greater ease, enter a new piece of work. The foot of the spindle is provided with a clutch for rod work, and with a set of head-holders for bolts.

It will readily be seen how the turning of the spindle causes the bolt to revolve between the cutters, and at the same time feed itself along after the automatic feed has been thrown in By an automatic adjustable throw-out the automatic feed is thrown off just before the end of the bolt is reached.

As before stated, the cutters

are pieces of bar steel, cut off to lengths and ground roughly and tempered. These are placed upon their edges and secured in grooves, and when arranged present the appearance of a hollow mill. The first set of these cutters are secured in the face plate, as shown. Below and from this plate extend rods, upon which other plates may be secured, holding similar cutters. As many of these plates are employed as there are shoulders in the bolt or rod to be turned, the lower one being used to square up the end.

The advantages claimed for this machine are the accuracy secured and the cheapness of product.

The machine illustrated is arranged to turn bolts from 1½ inches diameter, to ¾ and under. With ordinary work it is difficult to produce a difference of over one or two thousandths of an inch between the largest and the smallest of a given size of bolts.

The economical running of the machine is much increased with the number of machines employed, and as the taking out and entering of the bolt requires but a moment, it is evident the longer the bolt, the greater the number of machines one operator can run.

It is claimed that the setting of this machine requires but little longer time than to set a lathe tool, to turn a given size; and when once set, is good with ordinary tool steel for a day's use. It is also claimed that from an examination of the principles involved, it will be seen that the friction is reduced to a small matter, all bearings being cutting edges and different from the hollow mill in which friction is largely increased by the closing up of the cutting ends, to secure uniformity of size, and by the wear of the edge. These machines are made by Nicholson & Waterman, Providence, R. I.

The Eclipse Ice Making and Refrigerating Machine.

The engravings, Figs. 1, 2 and 3, accompanying this, show quite fully the design and construction of machinery for producing cold air, as made by Frick Company, of Waynesboro, Penn. For the following description and useful general matter on the subject of refrigeration, we are indebted to the inventor, Edgar Penney, general superintendent for the Frick Co.:

The cuts were made from photographs of actual machines, the larger one being of 50 ton and the smaller of 20 ton refrigerating capacity; that is to say, for each 24 hours' continuous operation the machines will produce cold air equivalent to the melting of 50 and 20 tons respectively of ice in same length of time.

Vertical single-acting gas compressor pumps are used. These pumps are driven by horizontal engines, the larger sizes having Corliss valve gear, the smaller sizes being plain slide valve, provided with Tremper automatic governors.

The principal feature in the design is the employment of square tapering columns which are box girders "stood on end," the bottom ends of which terminate in a broad flange flush with the floor, the foundation plates to which they are bolted being concealed in the masonry. The fly wheel is situated between the pair of pumps. The engine connecting-rod passes through one of the columns and connects upon the pump wrist-pin direct. The general features of the construction are apparent upon inspection of the engravings, and need no further explanation.

Anhydrous ammonia is the refrigerant used. The operations whereby this chemical is made the vehicle for producing cold are comparatively well known, but as some reader may not be aware of the processes and peculiar properties of this liquid, we will briefly state that ammonia is in fact only one of a large number of liquids and gases that have been employed to produce cold air by mechanical means, and it is only by reason of its great superiority over all others in actual practice that can account for its general use, not only practice, but a theoretical knowledge of the properties of this gas point to its being the best.

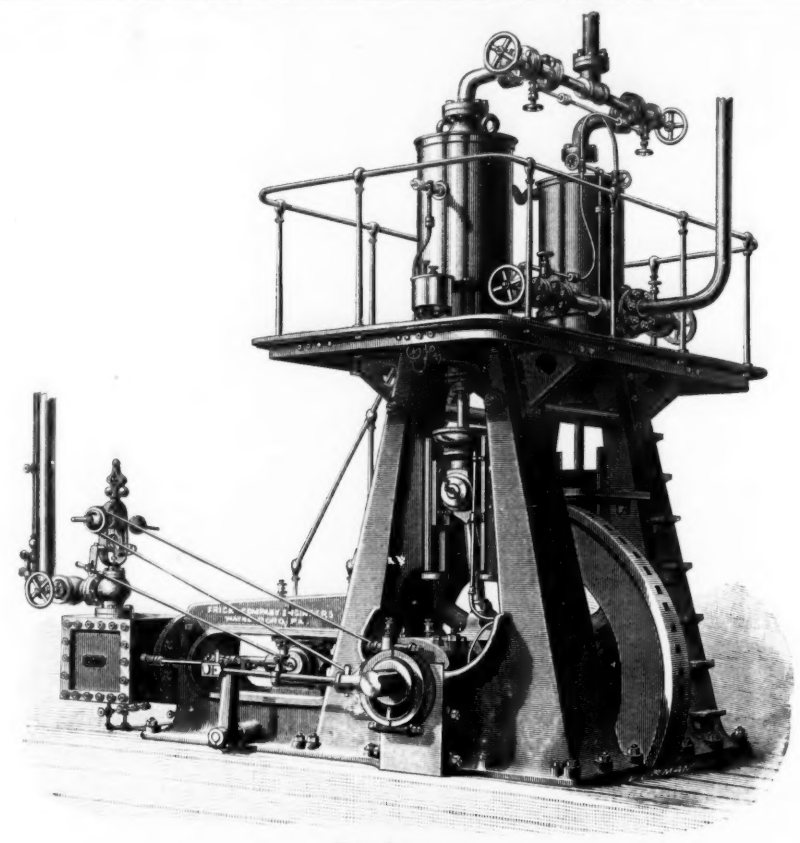


FIG. 3.

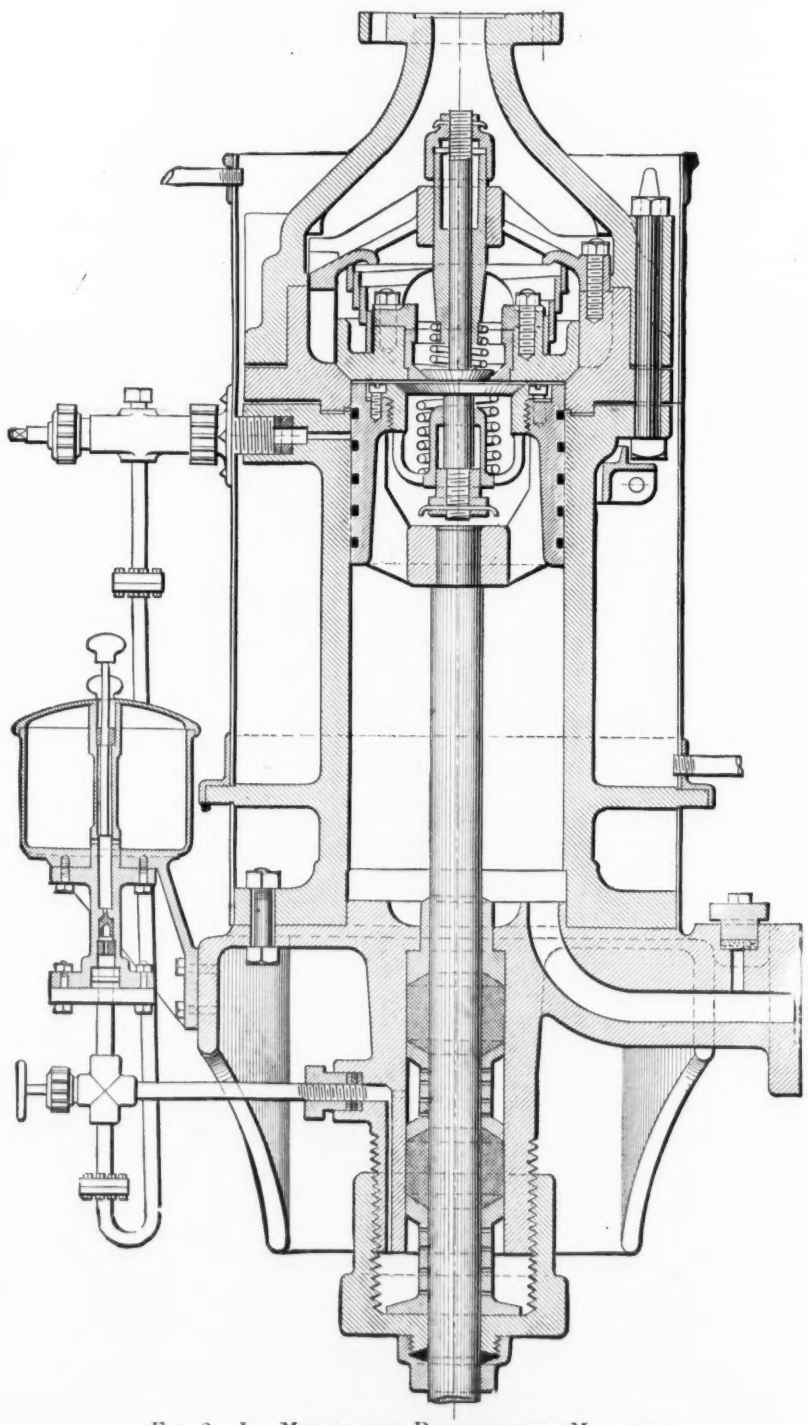


FIG. 2.—ICE MAKING AND REFRIGERATING MACHINERY.

So far as the writer is aware, no exhaustive experiments have been carried out to determine, as has been the case with steam and other gases, the pressure, temperature, density and volumes of ammonia, but enough is known to indicate, with a close approximation to the truth, its principal properties. For instance, it is stated by good authority that ammonia liquid weighs 39 pounds to the cubic foot, its specific gravity is 0.5894, specific heat at constant pressure is 0.508, its latent heat of evaporation is 900° F., boiling point at atmospheric pressure is 40° F. below, and at 320° F. at the pressure of the atmosphere 1 pound of the gas will occupy 21.017 cubic ft. In looking over these data the engineer will be impressed with three things—that the liquid, while only a little more than half as heavy as water, has a boiling point 252° F. below water and a capacity for latent heat nearly equal to steam, 900° F.

The gas also liquefies easily under pressure, especially when the gas is discharged from the pumps, and maintained under constant pressure in a surface condenser where the specific and latent heat is rapidly carried off by the condensing water. Roughly calculated, with condensing water, at 50° F., the pressure of liquefaction is about 65 pounds per square inch; at 60° F., it is about 98 pounds; at 82° F., 150 pounds.

The pressure of the gas rises very rapidly for each increment of temperature; for instance, at 32° F. it equals 50 pounds per square inch; at 61° F., 100.5 pounds; at 77° F., 140 pounds; and at 104° F., 225 pounds.

It is now easily understood why this gas, with its low boiling point, great latent heat capacity and moderate compression pressure of liquefaction, has come to be such a favorite with refrigerating machine builders. But while the gas lends itself favorably to the builder in some respects, it for a long time, like an untamed and powerful wild beast, refused to be harnessed and utilized—the chief difficulties being the extreme rarity of the gas, which made it difficult for ordinary materials and methods of construction to hold it; in other words, it would leak in spite of all precautions. This has at last been fully overcome, and the secret, which is no secret at all, is to use proper mixtures of iron and correct method in the foundry parts, and the use of steel and wrought-iron in other parts of the construction, and to test everything rigidly and thoroughly. Without this, failure is certain. Only the best of workmanship is admissible.

The parts belonging to a modern ammonia refrigerating machine and its operation is first a compressor pump, the gas being drawn into the same under a pressure of 5 to 25 pounds per square inch, called back pressure, and then compressed to the liquefying pressure, called condensing pressure (depending upon the water) being discharged from the pump into the condenser; from the condenser it is allowed to escape in a small stream through an expansion valve into a series of pipes, which in some cases are submerged in a bath made of a brine of full density of some one of the salts and water—common salt and water will do, and is practically non-congealable; in other cases the series of pipes are carried through the rooms to be cooled; in either case the large cubic contents of the pipes afford room for the expansion of the liquid into a gas, and, owing to the large quantity of latent heat stored by the gas in passing from the liquid to the gaseous state, surrounding objects are rapidly cooled, and of course, if the liquid is completely gasified, it has taken up all the heat possible, and has chilled the brine or air of the room in contact with congealing pipes proportionate to the supply of liquid, which is regulated at the expansion valve. The gas, after forming, is pumped back to the condenser and reliquefied.

Where brine is used it is pumped into pipes in the rooms to be cooled instead of ammonia, the one being known in the trade as *brine circulating system*, the other as the *direct expansion system*. So far as the machine is concerned, and general principle, the two systems are identical.

The most important feature of a refrigerating machine is the compressor pump, and to secure the highest efficiency of performance, the pump, other things—such as proper application and proportion of steam engine driving same, and lowest obtainable loss by friction of transmission of power to pump—being equal, that pump which receives the fullest charge of gas and most perfectly expels the charge is the most efficient, taking for granted that both are tight. The pump shown in Fig. 2 shows an admir-

able construction. To obtain in the fullest measure these much to be desired qualities, the piston is long, using five spring rings carefully fitted, particular pains being taken with the bore to have it round and parallel. The suction valve, of large area is situated in the piston, the gas inlet being in the base of the pump. The suction valve being balanced by a spring, it affords upon the return stroke of the piston, no resistance to the gas, which flows under the back pressure, and with considerable velocity, into the vacant space above the piston. A cushion spring assists in closing the suction valve promptly as the up stroke is begun, compressing the gas, which is gradually compressed until it equals the condensing pressure acting upon the relief valves located in the pump dome. The gas, on being compressed, parts with more or less of the heat of compression through the wall of the cylinder, the dome and cylinder being enveloped by a copper jacket through which cold water is constantly circulating. This jacket water not only prevents superheating of the gas during compression, but also carries off much of the specific heat of the compression and some of the latent heat, materially assisting the condenser and cutting down to a marked degree the resistance to compression that would present themselves without its use. As a matter of fact, it is so much gained at the slight cost of the jacket water.

In order to make it absolutely safe to work the piston metal to metal against the top cylinder head, thus to better expel the full charge, the head is made movable, or what may be called a safety head; in other words, it is simply a large valve the full size of bore of pump, through the seat of which the piston may pass, raising the head with it sufficient so in case of any small part getting loose and lying between these surfaces, no damage can ensue, as knocking out the cylinder head and losing, as is the general case, the full charge of ammonia gas amounting in some cases to many hundred dollars; ordinarily the large valve does not work, the operating discharge valve being the small steel valve in the center of the safety head. Notice that the discharge valve, with its guides, speeder and false seat, are self-contained and independent of the pump cylinder, making it possible to replace the whole mechanism by a new one or make speedy repairs.

The stuffing box of the piston rod is arranged with great care to prevent leakage of gas, and amply lubricated by means of a hand pump and oil reservoir. The small valve at the upper left hand corner is for taking indicator diagrams from the pump and to inject oil in that portion of the cyclinder.

This machine is largely in use for breweries, cold storage house and provision chill rooms, by pork packers, etc. The sizes range from 2 to 150 ton refrigerating capacity, the Armour Packing Co., of Kansas City, having a 100 ton machine of this pattern. The weight of the machine alone is 76 tons.

Next Meeting of Mechanical Engineers.

The American Society of Mechanical Engineers will hold their next meeting at Philadelphia, beginning November 28th. The sessions will probably be at the Continental Hotel, although this is not definitely settled. A reception at the Art Gallery will be included in the programme.

Following is a list of questions for topical discussion, as far as received:

50. What is the best form of pump to use with driven wells, where lift is ten to twenty feet, and air is likely to get into the suction? Should the pump be single or duplex, and with piston or plunger?

51. Have you used driven wells successfully? Of what sizes and depths, and singly or in groups?

52. Are roller bushings expedient in journals at low velocities and under high pressures?

53. What is the best material for lining brake-straps on elevators, cranes, etc.?

54. What is the best way to secure tight fit of set-screws tapped into heavy parts of a machine?

55. How much should be removed from the edges of punched or sheared steel plate to cut away the injured metal?

56. Have you used power moulding machines successfully in the foundry?

57. What makes the best moulds for complicated steel castings, to secure solidity and freedom from shrinkage cracks?

58. What is the effect of adding small per cents of wrought-iron or steel scrap in the foundry cupola or ladle?

59. What kinds of pig iron give the best results in light castings where easy tool-treatment is the essential rather than strength?

There seems to be little doubt but the absorption of all the telegraph lines in the country by one huge monopoly will bear fruit in an effort by the next Congress to regulate the matter in some way. This will not, at present, amount to much, but such things are likely to grow.

Paper window glass is one of the newest inventions. A window pane is made of white paper manufactured from cotton or linen and modified by chemical action. Afterwards the paper is dipped in a preparation of camphor and alcohol, which makes it like parchment. From this point it can be molded and cut into remarkably tough sheets, almost transparent, and it can be dyed with almost the whole of the aniline colors, the result being a translucent sheet showing far more vivid hues than the best glass exhibits.—*Boston Journal.*

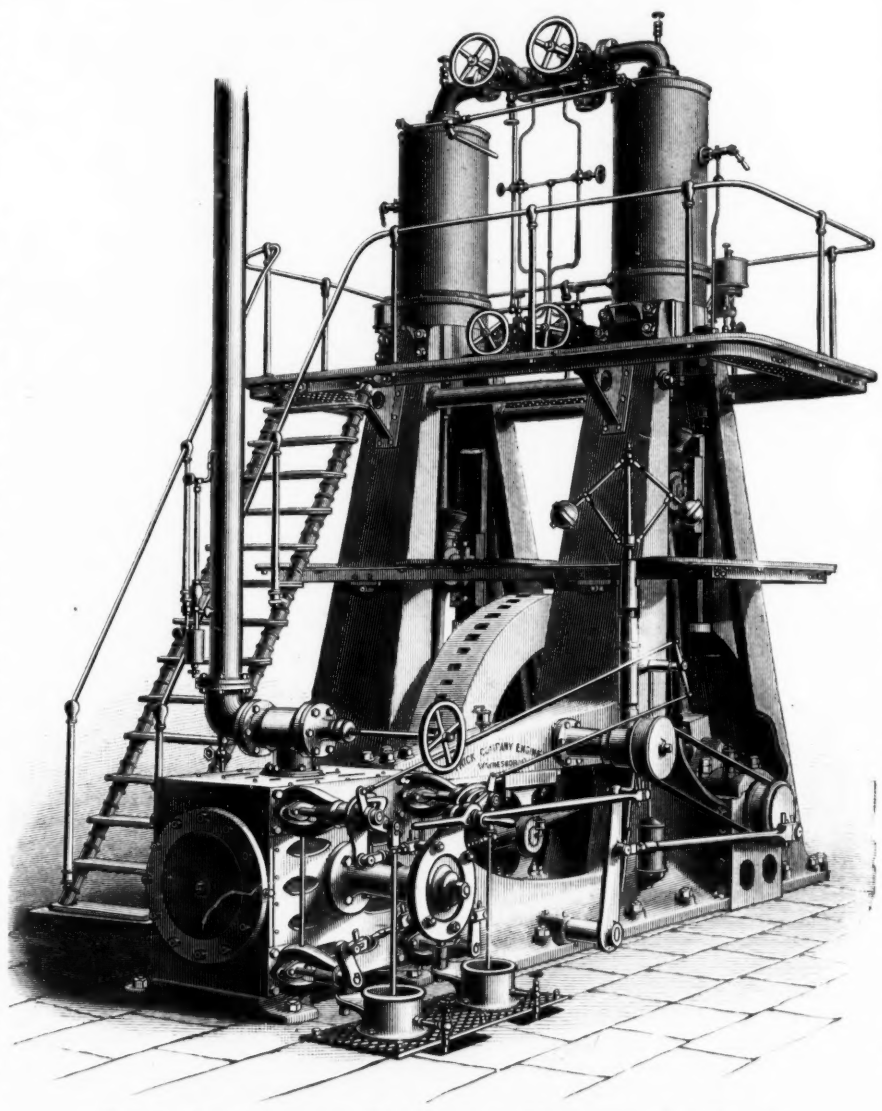


FIG. 1.—ICE MAKING AND REFRIGERATING MACHINERY.—SEE PAGE 2.

The New York Central Railroad Co. is relaying portions of its track with steel rails weighing 80 lbs. to the yard; while the Pennsylvania road is using 90 lbs. rail for the same purpose. This movement is quite significant, and may turn out to be of considerable importance to the iron and steel industries. The fact is that on these roads and others the traffic has become so heavy that much heavier engines, moving at much higher rates of speed than formerly, are required, the result being that the rails weighing 60 lbs. to the yard, which have been heretofore considered standard in this country, are being rapidly pounded to pieces and destroyed. We believe that on account of increased durability and decreased liability to those accidents which result from broken rails, the change will be found to be a paying one. If so, many miles of road will in the near future be relaid with the heavier rail; the increased amount of iron thus consumed resulting in great benefit to the iron and steel industries. And here the question naturally suggests itself whether or not the heavier rails will not be considered to allow of still heavier and more rapidly moved rolling-stock until the contest between the track men and the motive power men, will resemble that between the makers of armor and of guns with which to destroy it.

The Lick Telescope.

What is in many respects the most remarkable and interesting mechanism ever constructed, the Lick telescope, has just been completed at Cleveland, Ohio, by Messrs. Warner & Swasey. The object glass, with its cell, by Alvan Clark & Sons, weighs 638 lbs. The steel tube in which it is mounted is 56 ft. 6 in. in length, 4 feet diameter at the center and 38″ at the ends, weighing, with its attachments, 8,600 lbs. It is supported by polar and declination axes of steel, 10 feet long, 12″ and 10″ diameter, respectively. The column which supports it is 10x17 feet at the base, 4x8 feet at the top, and weighs 36,000 lbs. The weight of the whole instrument complete is 65,000 lbs. The moving parts, notwithstanding their great weight, may be moved so as to direct the telescope to any desired point by a light pressure of one finger, this being the result of their being so accurately balanced and mounted upon anti-friction bearings. A large part of its work is to be astronomical photography. For this purpose it is necessary to keep the image of a star steadily upon a certain point for some hours, and of course this can only be done by moving the telescope at precisely the same rate as that of the star. There is accordingly a clock in the column, which, when connected to the telescope by the astonomer, causes it to move in exact sidereal time. The instrument is by far the largest of the kind ever constructed, and yet is of such excellent design and construction as to make it unusually convenient and easy to manipulate.

We think it will prove to be a lasting honor to its builders, and a credit to American mechanical skill and ingenuity.

New Machine Works.

On a visit to the shops of the Springer Torsion Balance Co. recently, we found quite a variety of new and high grade machine tools in position. These are being used at present chiefly in tool-making, with a view to the extensive manufacture of torsion balances.

The tension of the steel bands upon which the levers of the balance are supported, is tested and regulated by musical pitch, comparison being made with a zither.

An original idea was carried out in the erection of the new shops of this company. They are built in Jersey City and are so located as to make it impossible to enlarge them should more room be required in the future. Consequently they are built in the form of an apartment house, so that if it becomes necessary they may be abandoned and made use of for dwellings. For supplying steam, a vertical boiler is used, which is high enough to project through the second floor, and upon the top of it is rigged an oven of sheet iron, under which the heated gases pass, and in which are placed articles to be japanned, or anything requiring such heating.

A meeting of clergymen was recently held in New York in response to a call from the Church Association, for the Advancement of the Interests of Labor. Among the principles of the society which were read, were clauses declaring that:

3. Labor, being the exercise of body, mind and spirit in the broadening and elevating of human life, it is the duty of every man to labor diligently.

4. When the divinely intended opportunity to labor is given to all men, one great cause of the present widespread suffering and destitution will be removed.

Addresses were made by Bishop Huntington and others, some of the ministers declaring that they belonged to labor organizations.

The mechanical facilities of the navy yards in the United States are very justly considered as shameful. It would be advantageous to, if necessary, dispense with some of the yards and put the others in condition to do work according to modern practice. It is little wonder that a few years' work in a government yard gets a man so much out of good practice as to impair his usefulness.

As cold weather comes on, necessitating the closing of doors and windows, there are many machine shops in which, from lack of ventilation, the air is almost unbearable to an outsider. The added amount of work that would be done in such shops would pay the cost of arranging for ventilation, about four times in the year.

The long winter evenings now at hand afford excellent opportunity for reading and studying by young mechanics, and also call attention to the desirableness of those towns and cities where opportunities are afforded mechanics for meeting together for studying mechanical subjects.

At a recent explosion of dynamite at Dover, N. J., a steam engine was sent through the roof of a building one hundred and fifty feet away, and the fact that it didn't explode was a serious puzzle to those who furnish news to the associated press.

It is significant that those who use natural gas, even in localities where it is presumed to be inexhaustible, are arranging their furnaces to use coal when the gas supply temporarily fails.

Experiments that have recently been made to determine the practicability of using gunpowder to project dynamite shells are said to have been satisfactory.

Practical Drawing.

By J. G. A. Meyer.

THIRTY-SEVENTH PAPER.

Problem 47.

PRACTICAL APPLICATION OF PROBLEM 46.

367. The solution of Problem 46 can be applied in various ways to every-day practice. For instance, let Fig. 252 represent the outline of the end of a roof, and Fig. 253 the plan of the outline of the same roof; it is required to make from these two views an outline of end of this roof in which the true lengths of its edges and the true magnitudes of the angles formed by these edges can be seen. Fig. 255 is a side view of the same roof, and is supposed not to be given with the other two views. Our object of showing it here is to make the following explanation as plain as possible.

Through the point e_2 in Fig. 253, draw a straight line perpendicular to the line $c_2\ d_2$ and cutting it in the point f_2. In Fig. 252 draw through the point e a line perpendicular to $c\ d$, cutting it in the point f. On the line $c\ d$ and from the point f lay off another point f_4; the distance between the points f and f_4 must be equal to that between the points e_2 and f_2 in Fig. 253. Join the points f_4 and e by a straight line.

If now, in Fig. 255, we draw through the point e_4, a line $e_4\ f_5$ perpendicular to $d_4\ i$ and cutting it in the point f_5, then will the line $d_4\ f_5$ be equal to the line $e_2\ f_2$ in Fig. 253; but the line $f_4\ f$ is also equal to $e_2\ f_2$; therefore $d_4\ f_5$ is equal to $f_4\ f$, and since $e_4\ f_5$ is equal to $e\ f$, it follows that $e\ f_4$ is equal to $e_4\ d_4$; in fact, the line $e\ f_4$ represents the true perpendicular distance between the point or corner e and the line or edge $c\ d$.

Draw any horizontal line $c_3\ d_3$ (Fig. 254) and make its length equal to that of the line $c_2\ d_2$ or $c\ d$. Through the center f_3 of the line $c_3\ d_3$ draw a line $f_3\ e_3$ perpendicular to $c_3\ d_3$. On the line $f_3\ e_3$ from the point f_3 lay off a point e_3. The distance between the points f_3 and e_3 must be equal to the length of the line $e\ f_4$; join the points c_3 and e_3, also d_3 and e_3 by straight lines; then will the triangle $c_3\ d_3\ e_3$ thus formed be the true outline of the end of the roof, in which the true length of the edges and the true magnitudes of all the angles formed by these edges can be seen.

The true magnitude of the angle formed by the edges $i_2\ d_2$ and $e_2\ d_2$ (Fig. 253) can readily be found in the following manner:

Through the point e_2 (Fig. 253), draw a line $e_2\ e_5$ perpendicular to the line $i_2\ d_2$, and cutting it in the point e_6; from this point lay off on the line $e_6\ e_5$ a point e_4; the distance between the points e_6 and e_5 must be equal to the length of the line $d\ e$ in Fig. 252. Join the points d_2 and e_5 by a straight line; then will the angle $e_6\ d_2\ e_5$ represent the true magnitude of the angle formed by the edges $e_2\ d_2$ and $d_2\ i_2$. If these constructions are correctly made, the line $d_2\ e_5$ will be equal to the line $e_3\ d_3$ or $e_3\ c_3$.

The principles upon which the latter construction is based are given in Articles 332 up to 343.

Directions.—In the space marked Problem 47, draw the outline of the end, and the outline of the plan of a roof according to the dimensions given in Figs. 256 and 257; use a scale $\frac{1}{8}$ of an inch to the foot. Find the correct outline of the end $c_2\ d_2\ e_2$ of the roof and the true magnitude of the angles formed by the edge $c_2\ e_2$ and the longitudinal edge, also the true magnitude of the angles formed by the edge $e_2\ d_2$ and the longnitudinal edge.

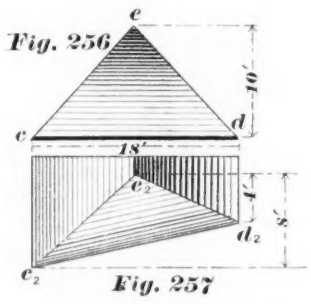


Fig. 257

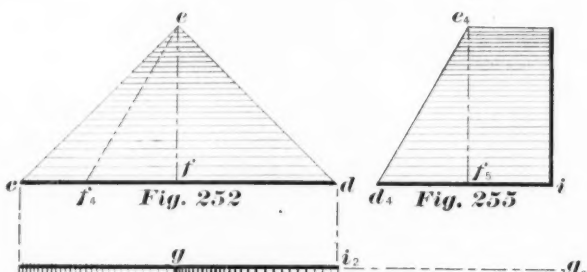


Fig. 252

Fig. 255

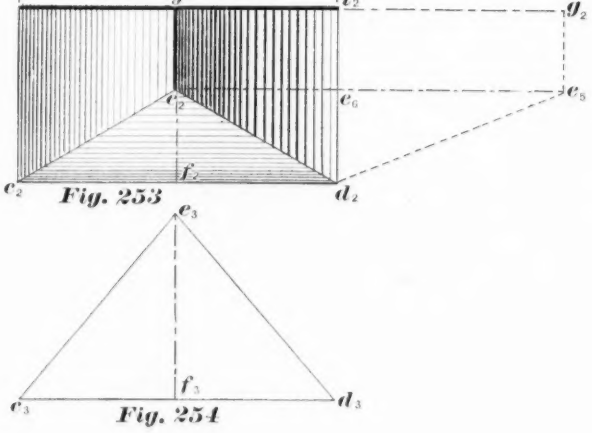


Fig. 253

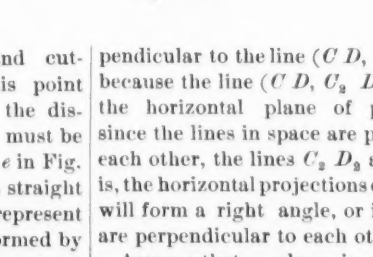


Fig. 254

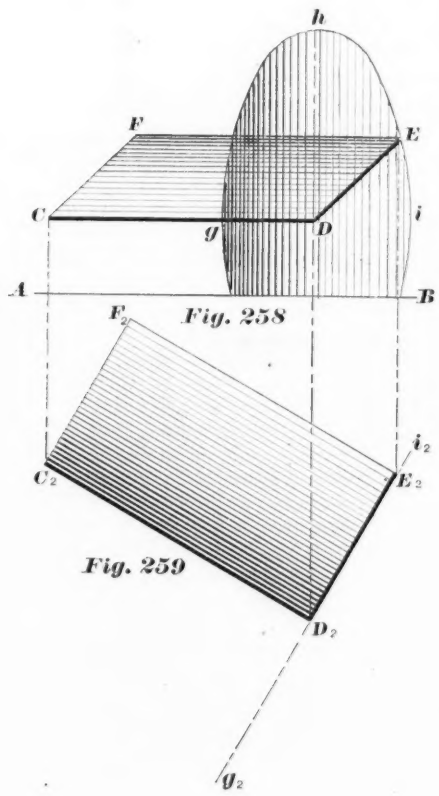


Fig. 258

Fig. 259

Proposition 48.

368. IF TWO LINES IN SPACE ARE PERPENDICULAR TO EACH OTHER, AND ARE PROJECTED ON A PLANE TO WHICH ONE OF THE LINES IS PARALLEL, THEIR PROJECTIONS ON THAT PLANE WILL ALSO BE AT RIGHT ANGLES.

In Article 350 it is stated that the correct size or true magnitude of an angle which is greater or less than a right angle formed by two lines in space, cannot be seen in the projection of the lines, unless both lines in space are parallel to one or the other plane of projection. It is now to be explained, that if two lines in space form a right angle, or in other words, if these lines are perpendicular to each other, and only one of these lines is parallel to either plane of projection, then the true magnitude of the angle which they form can be seen in the projection of the lines on that plane to which one of them is parallel; or in other words, the projections of the lines on that plane to which one of the lines is parallel will be perpendicular to each other.

Figs. 258, 259. Let $A\ B$ be the ground line, $C\ D$ the vertical, and $C_2 D_2$ the horizontal projection of the line which is parallel to the horizontal plane of projection: $D\ E$ and $D_2\ E_2$ the projection of the line which is perpendicular to the line ($C\ D$, $C_2\ D_2$). Now, because the line ($C\ D$, $C_2\ D_2$) is parallel to the horizontal plane of projection, and since the lines in space are perpendicular to each other, the lines $C_2\ D_2$ and $D_2\ E_2$, that is, the horizontal projections of lines in space, will form a right angle, or in other words, are perpendicular to each other.

Assume that a plane is passed through the given lines in space, and for the sake of clearness let this plane be of definite dimensions, that is to say, let it be a rectangular plane whose length is equal to the line ($C\ D$, $C_2\ D_2$) and its width equal to the line ($D\ E$, $D_2\ E_2$) then will the parallelogram $C\ D\ E\ F$ represent the vertical, and the rectangle $C_2\ D_2\ E_2\ F_2$ represent the horizontal projection of this plane. Suppose now that this plane be turned around the line $C_2\ D_2$, then the line ($E\ D$, $E_2\ D_2$) will move in a plane which is perpendicular to the line ($C\ D$, $C_2\ D_2$). (See article 322.) Since this plane is perpendicular to the line ($C\ D$, $C_2\ D_2$) and since this line is parallel to the horizontal plane of projection, it follows that the plane must also stand perpendicular to the horizontal plane of projection; the line $g_2\ i_2$ is its trace, and this trace is perpendicular to the line $C_2\ D_2$; but the line $g_2\ i_2$ contains the horizontal projection of the line ($D\ E$, $D_2\ E_2$) because it is the trace of a plane which passes through the line ($D\ E$, $D_2\ E_2$) and stands perpendicular to the horizontal plane of projection. (See Arts. 233 and 236.) From the foregoing we learn that when the plane $C_2\ D_2\ E_2\ F_2$, which contains the line ($D\ E$, $D_2\ E_2$) is revolved about the other given line ($C\ D$, $C_2\ D_2$) which is parallel to the horizontal plane of projection, the line ($D\ E$, $D_2\ E_2$) will move in its projecting plane, and therefore the horizontal projection of this line will always be found in the trace $g_2\ i_2$ and be perpendicular to the line $C_2\ D_2$, which is the horizontal projection of the other line.

In revolving the plane $C_2\ D_2\ E_2\ F_2$ about the line $C_2\ D_2$ the extremity E_2 of the line ($D\ E$, $D_2\ E_2$) will describe a circle, and of course this circle will lie in the plane which is represented by the trace $g_2\ i_2$, and which, as will be seen, stands in an oblique position to that of the vertical plane of projection, and therefore the path of the point (E, E_2) in Fig. 258 cannot be represented by the circumference of a circle, but is shown by a curved line, $g\ h\ i$, which in fact represents the circle standing in an oblique position.

Again, assume that the plane $C\ D\ E\ F$, Fig. 258, is revolved about the line $C\ D$ till it stands parallel to the vertical plane of projection, then, since the plane contains the line ($D\ E$, $D_2\ E_2$), this line will also be parallel to the same plane of projection; in this position $D\ h$ will be the vertical projection of the line ($D\ E$, $D_2\ E_2$) and the point D its horizontal projection. In revolving the plane $C\ D\ E\ F$ the position of the line $C\ D$ will not be changed, and because it is parallel to the horizontal plane of projection, will remain parallel to the line $A\ B$, and since $D\ h$ is perpendicular to $A\ B$, it follows that the angle formed by the lines $D\ h$ and $C\ D$ will be a right angle, and in the horizontal plane of projection both lines will be represented by one line, namely the line $C_2\ D_2$. This example gives us another case in which the true magnitude of the angle formed by two lines perpendicular to each other in space can be seen in the projection of these lines on that plane to which one of them is parallel.

It should also be noticed, that in revolving the plane $C\ D\ E\ F$ about the line $C\ D$, the point D remains stationary and the point E moves in the path represented by the curved line $g\ h\ i$, and consequently the vertical projection of the line ($D\ E$, $D_2\ E_2$) will become longer as the plane is revolved from its position shown, to a position parallel to the vertical plane of projection. During the same revolution of the plane the point E_2 in Fig. 259 will move towards D_2—which remains stationary—in a path represented by the straight line $g_2\ i_2$ and therefore during this revolution of the plane the horizontal projection of the line ($D\ E$, $D_2\ E_2$) will become shorter, and when the plane stands perpendicular to the horizontal plane of projection the line ($D\ E$, $D_2\ E_2$) will be represented simply by the point D.

Directions.—In the space marked Prob. 48 draw the ground line $A\ B$; below this ground line draw the line $C_2\ D_2$, which, when prolonged, will make an angle of 30 degrees with the line $A\ B$, and drawn in a direction in which the line $C_2\ D_2$ will cut the line $A\ B$ in point situated towards the right in the line $A\ B$. Through any point D_2 in the line $C_2\ D_2$, draw a line $D_2\ E_2$ perpendicular to the line $C_2\ D_2$, and assign some definite lengths to the lines $C_2\ D_2$ and $D_2\ E_2$. In following these directions, the angle $C_2\ D_2\ E_2$, formed by these lines will lie between the ground line $A\ B$ and the extremities C_2, E_2; that is to say, the point D_2 will be closer to the ground line $A\ B$ than the points C_2, E_2, and not as shown in Fig. 259. The next step will be to find the vertical projections of the lines which are represented by the lines $C_2\ D_2$ and $D_2\ E_2$. Assume that the line represented by $C_2\ D_2$ is parallel to the horizontal plane of projection. Then we must represent this line, which is situated in space, by a line $C\ D$ parallel to the ground line. Hence, anywhere above the line $A\ B$ and parallel to it, draw a line $C\ D$; through the extremities C_2, D_2 draw the vertical lines $C\ C_2$ and $D\ D_2$ cutting the line $C\ D$ in the points C and D, then will the line $C\ D$ be the vertical, and $C_2\ D_2$ the horizontal projection of a line in space which is parallel to the horizontal plane of projection. Through the extremity E_2 draw the vertical line $E\ E_2$. Through the point D draw a line $D\ E$, making an angle of 120 degrees with the line $C\ D$ and cutting the line $E\ E_2$ in the point E, then will the line $D\ E$ be the vertical, and $D_2\ E_2$ the horizontal projection of a line which is perpendiclar to the line represented by the projections $C\ D$ and $C_2\ D_2$.

Again, draw through the point D another line making an angle of 150 degrees with the line $C\ D$ and cutting the line $E\ E_2$ in the point E_3 (this point is not shown in our illustrations); then will the line $D\ E_3$ be the vertical, and the line $D_2\ E_2$ (whose length has not been changed) the horizontal projection of a line in space, which also makes a right angle with the line ($C\ D$, $C_2\ D_2$).

Here the reader may ask: How is it that when two lines in space perpendicular to each other, one of them parallel to the horizontal plane of projection, the other line not parallel to this plane of projection, the latter can be represented by two lines in the vertical projection without changing the length of its horizontal projection?

To this we answer: The projections $D\ E$ and $D_2\ E_2$ represent a shorter line in space than that represented by the projections $D\ E_3$ and $D_2\ E_2$; again, the projections $D\ E$ and $D_2\ E_2$ represent a line which makes with the horizontal plane of projection an angle greater than that line which is represented by the projections $D\ E_3$ and $D_2\ E_2$. It is advisable for the student to find the correct length of the line represented by the projections $D\ E$ and $D_2\ E_2$, and also the length of the line represented by the projections $E\ D_3$ and $E_2\ D_2$. For the sake of practice, the length of the former line should be found in the vertical projection; that is to say, this construction should be made above the ground line; the length of the latter line should be found in the horizontal projection. The curved line $g\ h\ i$ in the vertical projection need not be shown, we have not yet given any method for finding this line.

The Binghamton Hydraulic Power Co.'s Water Motor.

The engravings presented herewith illustrate a new water motor manufactured by the Binghamton Hydraulic Power Co. of Binghamton, New York. They are made in eight sizes, ranging from 6″ to 30″ diameter of wheel, and to develop from ¼ to 8 horse power, according to size and pressure of water supply. Fig. 1 shows the general appearance of the motor, and Figs. 2 and 3 show the construction and arrangement of the parts.

The water is supplied through the pipe indicated in Fig. 2, and fills the column above. From this it is forced, through the three nozzles shown, directly into the buckets of the wheel, to which it imparts its momentum and escapes beneath. Plungers are fitted into the column opposite the jets, which, by means of the levers shown in Fig. 1, open or close any one or more of the jets; thus regulating the supply of water to suit the desired amount of power without reducing the pressure or velocity of the water impinging upon the wheel. This feature, it is claimed, secures good economy in the use of water, whether the full or only a part of the capacity of the motor is required.

Only the larger sizes have three jets, the smaller ones having two.

The 22″ machine, to develop from ½ to 5 horse-power, according to pressure of water supplied, occupies a floor space of 30″ × 18″ and is 30″ high. The agents in New York are Cooke & Co., 22 Cortlandt street.

FIG. 1.

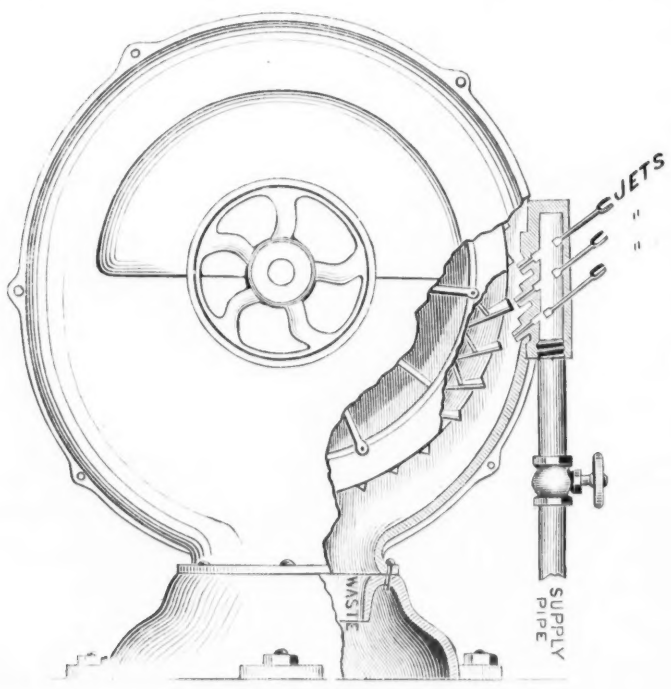


FIG. 2.

THE BINGHAMTON WATER MOTOR.

Mill Gearing on the Rope System.

BY W. H. BOOTH.

The old system of mill gearing in England was by toothed gearing, and it was not until about fifteen years ago that the American wide-belt system began to displace the old-fashioned gearing. The belt system made very slow progress in England. however, and before it had been at all extensively adopted a newer system sprang up and made such rapid progress as not merely to almost entirely supplant the old wheels, but also to put an almost complete stop to the further development of belt driving, though large double belts of great width are still occasionally employed. Various reasons have led to the success of the rope system, one of which is that the ropes, being chiefly made from cotton, were looked upon with favor by the cotton manufacturers, and they were also handy in application; much more so than wide belts, as they could be handled individually. So rapid has been the progress of the new system that hardly a new mill is now constructed in which ropes are not employed. The general experience is not altogether in favor of ropes, for it is commonly conceded that whilst a good belt requires 5 per cent. more power than toothed gearing, the rope gear requires a further 5 per cent. of power for the same result in spindles turned. In favor of ropes is urged their quiet working and their steady turning. As to their quiet working we could point to mills where iron and iron gears are at work with little more sound, and as to steady turning we would point out that the rope pulley of a pair of 40-inch cylinders weighs probably 60 tons or more, whilst the spur gear of the same engines would not weigh over 25 tons, in all likelihood; and whilst the rope pulley will be 28 feet diameter, the old spur wheel would be no more than 23 feet. Further, modern notions of speed have given the heavier pulley a higher velocity of rotation than the spur wheel, and it is rather to this combination of weight and rim velocity that the steady turning is to be attributed than to anything especially inherent in the system itself, our argument being that with equal weights of fly wheel the spur gearing would show quite as good results in steady turning as any belt or rope.

Having thus premised, we may inquire into the design of rope gearing and investigate some of the conditions governing its efficiency and limiting its application and speed. Messrs. Kenyon, of Dukinfield, Cheshire, who are the leading manufacturers of cotton rope in England, consider that 7,000 feet per minute is about the limiting economic speed. Beyond this velocity the stress due to centrifugal action increases in a faster ratio than the strength or rather the efficiency of the rope, and it is important not to exceed the proper maximum velocity. Practical experience has shown that it is not advisable to use pulleys whose diameter is less than 30 diameters of rope, nor is it well to employ ropes of less than 1½ inches diameter.

A usual diameter is 1¾ inches, and a cotton rope of this size will weigh a pound to the foot run. A customary working total tension is 600 pounds per rope, and this includes not only the pull upon the rope due to the work performed, but also that due to the centrifugal force of the rope itself. Now the centrifugal force is to be found by *squaring* the velocity of the *rope in feet per second, and multiplying by the weight in pounds of a foot length of the rope. The product if divided by* 32 *will be the tension on the rope due to its speed alone.* Now this tension increases as the square of the velocity, the formula expressing the above rule being $C = \frac{W v^2}{g}$ where C is the centrifugal force. W, the weight of a foot of rope in pounds and v the speed in feet per second. g is of course the force of gravity or approximately 32 (32.2). It is a very simple matter to find the maximum proper velocity of a rope without the aid of higher mathematics. The first step is to find the centrifugal force and subtract this from the allowed total working tension of the rope. The remainder is the available tension for doing actual work in driving. If this be done for several different speeds, the final results when reduced to equivalent speed will show very nearly the best speed. We will take speeds of 50, 60, 70, 80, 90, 100, and 130 feet per second, equivalent to from 3,000 to 7,200 feet per minute. We will take the weight W as one pound per foot for 1¾ inch rope. Then the centrifugal tension in each case will be as per Table 1, page 6, and will be found to be very low, only 78 pounds for 3,000 feet per minute, and as high as 450 for a speed of 7,200 feet. In the third column is given the difference between the allowed total tension and the centrifugal tension or 600 — C. Let us take 80 as our standard speed, which gives a working tension of 400 left available after deducting centrifugal tension.

Then in column 4 are given the equivalent or relative powers of the rope at the different speeds, that at 80 feet per second being taken as 400. Column 4 is simply the amount in column 3, multiplied by the ratio of the speed to 80.

Thus at 50 feet speed we have $522 \times \frac{50}{80} = 326$ or the rope at 50 feet is only capable of doing actual work to the extent of 326 units, whereas at 80 feet it would do 400. This shows us that in spite of its larger remainder of 512, as compared with the 400 of the quicker rope, the speed gives the advantage to the quicker rope, but as the speed quickens and centrifugal tension increases as the square of the velocity, it is soon found that the increased power due to speed is more than counterbalanced by the rapid increase of the centrifugal tension, until at 150 feet per second, 9,000 feet per minute, we find that centrifugal tension alone is more than enough to account for all our allowed working stress, and even exceeds it by 100 pounds, and we find that at 139 feet per second, or about 90 miles an hour, all our working strength is used up simply in pulling the rope round, and if we wish to get any work out of a rope at a greater speed than about 8,340 feet per minute we shall require to work it at a higher stress or nearly its breaking load.

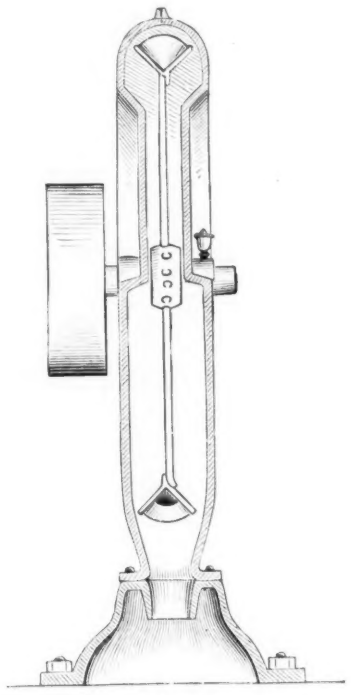


FIG. 3.

An examination of the table shows that 80 feet per second is the best speed, for a little closer calculation would show that at speeds of 79 and 81 feet, the number in the fourth column would be less than 400 and hence we conclude that for ropes of the strength and weight assumed, a speed of 4,800 feet per minute is about a proper maximum. At the same time, there is only a small variation on either side of this speed, and so far as the ropes are concerned it is of little consequence what speed is fixed upon between 70 and 90 feet per second. Messrs. Kenyon's limit of 7,000 feet is clearly wise, for at 7,200 we find only 225 against a maximum of 400. Some latitude is always required by the designer, and when the choice lies between a high speed of say 100 feet and a lower one of 70 feet the circumstances surrounding the case must be consulted. Either speed is equally advantageous for the ropes, and so the problem will then be one entirely governed by other circumstances. We may sometimes read of installations of rope gearing at 90 miles an hour. Our investigation shows that with ordinary ropes and customary working stresses such a speed is wholly wrong and ropes so run can do no work at all except at higher stresses. Any installation of rope gearing at 90 miles per hour must either be the product of ignorance on the part of the designer or a deliberate choice of a high working stress, possibly for some special case, where, on account of the peculiar circumstances, a high speed was admissible. Thus for a temporary installation, where a rope was not to be long in use, it might be perfectly justifiable to work it to as high as 1,200 pounds tension. Then at 139 feet per second, though centrifugal force would absorb 600 pounds, there would remain over 300 pounds, which, compared with our standard, would do work at the rate of $300 \times 139 \div 80 = 520$, or an increase of the working stress of 50 per cent. would give a rope of greater working capacity than when at standard speed at 600 pounds total tension. A study of this question teaches us that the most efficient ropes are those which have the greatest strength per pound weight, and in this respect hemp is superior to cotton, iron to hemp and steel to any. If the weight per foot of our ropes on Table 1 was half what it is, the figures in column 2 would be halved and the figures in column 4 would be increased to the amounts given in column 5, and we see that by halving the weight per foot we raise the maximum speed to something like 110 feet per second and so on, we may conclude that the better our material the more work we can get out of it. In the present case by purchasing a rope of double strength per pound weight we could get work out of it by raising its speed to the extent of 1,130 as compared with our original 400 from the heavier rope, and here comes in an important question ecconomically. We have got a doubly strong rope and out of it we get nearly treble the work; so that it would clearly pay commercially to give a more than double price for doubly strong rope, and a salesman who offers to supply the half strong rope at half the cost of the strong rope is only supplying goods to the value of two-thirds the true value of the higher price rope. Further, as fewer ropes would do the work, narrower pulleys are required and less attention all round. Buying cheap ropes, as many other cheap articles, may be a mistake for the cheap article has less

it and cannot compete with the better article at the higher speed, and with the present demand for high piston speeds the limit of rope speed ought to be high also, and therefore steam users and designers of engines should not fail to recognize the important facts above noted.

TABLE 1.

SPEED IN FT. PER SECOND. = V	$C = \frac{V^2}{32}$	600 − C	RELATIVE POWERS.	FOR $C = \frac{C}{2}$
50	78	522	326	350
60	112	488	366	408
70	153	447	391	458
*80 stan'd.	200	4.0	400	500
90	253	347	390	533
100	312	288	360	555
110	378	222	305	565
120 limit.	450	150	225	563
139	600	0	...	521
150	700	—100	...	469

The Milling Machine—Its Construction and Uses.

By John J. Grant.

VERTICAL FACE-MILLING MACHINES.

Often in small interchangeable work it is difficult to hold the pieces in a fixture for the first milling cut, when the piece has a flat surface on one or more sides or edges; this difficulty can be overcome by using a face-milling machine. Work to be face-milled must be bedded or sunk in the jig or fixture, so deep that but little more than the amount to be cut away is exposed. It is not essential that the work to be face-milled should be perfectly flat on the surface to be worked, but it must be in such shape as to allow the face milling cutter to revolve and not come in contact with any projection that may be on it, be extremely rigid in every particular, and strongly geared, as the whole surface of the work is operated on at the same time.

Fixtures for the face-milling machine should be made in the same manner as the common drill jig, with hardened steel legs. This allows the work to be lifted from the platen or bed of the machine, and the pieces to be dropped out. The fixture can also be easily cleansed in soda water when used for wrought-iron or steel work and brushed for cast-iron; it also facilitates the operation of putting in the pieces. Sketches of a machine, a fixture for common flat pieces, and a milling cutter, respectively, are shown in Figs. 1, 2 and 3.

In designing a face-milling machine for any special piece of work, it is best to cast the base or column, head, and table or platen all in one piece, to secure stiffness. It is well to augment this with rods or bolts, *A*, Fig. 1, as it is impossible to make a machine without putting in an enormous amount of metal, that will not spring away from the cutting enough to vary the sizes, especially those in the front part of the jig. When pieces are found to come thicker or thinner at the front or back of the machine simply tightening or loosening the nuts at the bottom of the rods is all that is required for adjustment; that is, unless there is too much variation. In that case it is necessary to adjust the legs of the fixture.

The spindle of the machine should be quite large and as short as possible, and the driving gear strong. The motion of the cutter being slow, about fifteen feet per minute at the periphery, and the cutting being over the entire surface, strong gearing and slow motion is essential. The driving gear should also be placed as near the cutter as possible, to prevent torsional spring. The original design shown embodies all these points, but is simply shown as a nucleus for the designer, around which he may build all the handy little attachments necessary for the special job the machine is constructed for.

As the cutters are generally of the same diameter, in fact, one set answering for nearly all varieties of work, the machine requires but little variation of speed on the driving shaft.

A power feed is not needed, and in fact cannot be used, as the distance traversed by the cutter spindle is but slight after it is brought down to the work.

The feed gearing, rack and pinion, should be amply strong, as the pressure is very great, and especially when the cutters are dull and the pieces being worked are hard. The hole in the bed or table, shown by the dotted lines, *B*, Fig. 1, should be bored out by the spindle of the machine itself after being erected, and must be in a perfect line with it.

A bushing hardened and ground inside and out, driven in, forms a bottom bearing for the stem of the cutter arbor.

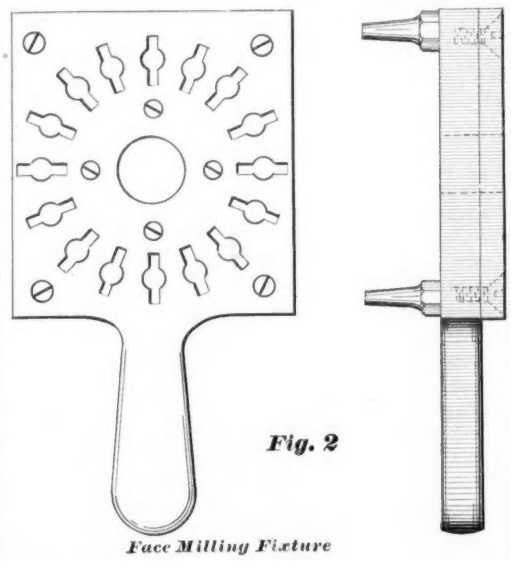


Fig. 2

Face Milling Fixture

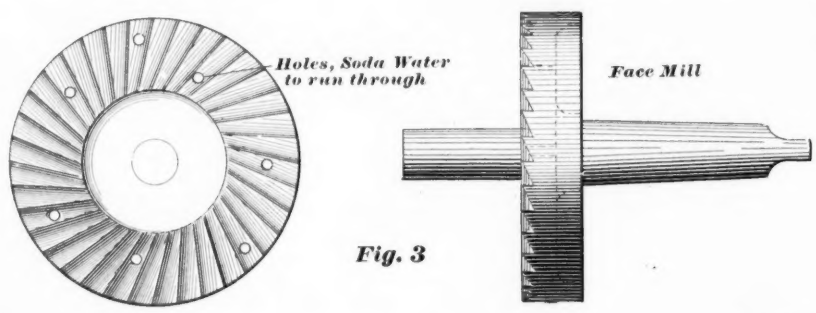


Fig. 3

Fixtures for the face milling machine can be made of cast-iron for temporary jobs, but for regular work in large quantities, steel is preferable. The feet should be large, not less than 1″ diameter, and after being ground on, the surface grinder should be stoned off around the edges, to prevent them cutting the platen of the machine. The hole through the center is large enough to allow the stem of the cutter to pass through free. In fitting or bedding the pieces to be milled it is often advantageous to make the fixture in two pieces, shown by the sketch, as they can be fitted to the top piece by cutting through it and then screwing it to the bottom or base. The handle serves to keep the fixture from turning by coming in contact with the bars at the side of the machine.

Cutters for the vertical face-milling machine can be made in various ways, either solid of steel, or with inserted cutters in a cast-iron head, but in all cases the teeth must be so fine that two or more teeth will be cutting at the same time on one piece.

The face and stem of the arbor to do good work must be absolutely true, and at right angles to each other. The teeth should not be tangent to the center, but to a circle about 2″ diameter; this arrangement of the teeth draws the chips away from the center.

The top of the cutter should be made "dishing," to hold the soda water or oil used in cutting. The clearance of the cut on the teeth should be very slight, as too much clearance will cause the cutter to "hog" into the work and often lift the pieces out of the jig.

Of course the uses of a vertical face-milling machine extend beyond the small special pieces mentioned, and those placed in a jig, as pieces of any size not too large to be covered by the cutter can be worked on by either holding in a vise or strapping them to the platen.

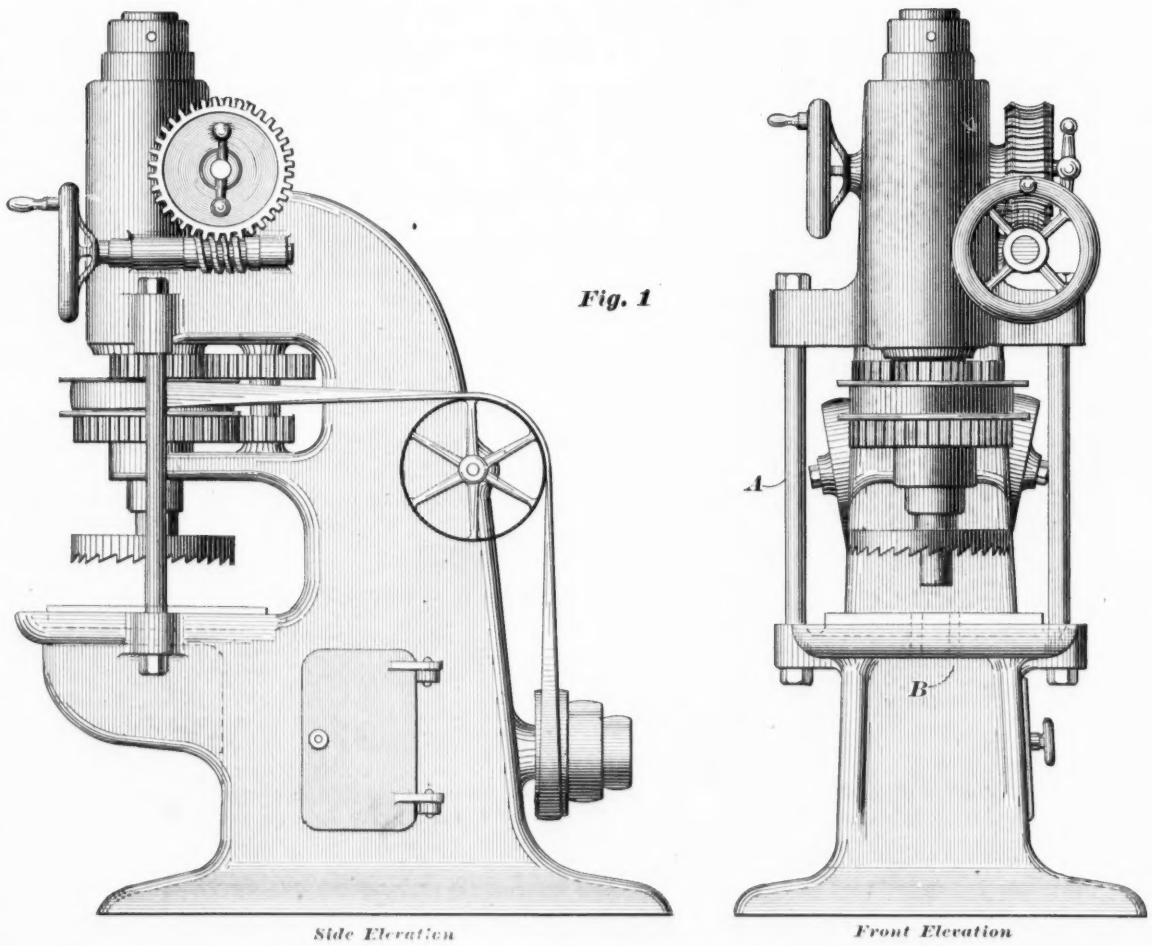


Fig. 1

Side Elevation *Front Elevation*

Association of Engineers of Ways of Communication.

The association above named is under special charter of the Russian Government, and is divided into several sections, including a section for a permanent technical exhibition in rooms under the charge of the association. There will be exhibited novelties and inventions both from Russia and abroad. Work in engineering in all branches, such as planing manufactories, machines, laying out canals, etc., etc., will be attended to. Such mechanical devices as are in use in other countries, and for which there may be sale in Russia, will be brought to the attention of probable purchasers, while information will be given abroad in relation to Russian products. In this respect we assume that the association acts in the capacity of an exchange. Russia is a large purchaser of mechanical products, and an association of the kind described ought to be able to do good work. The general agent for New York is A. Warschawsky, 14 Dey street.

Communication on Hot Air Heating.

Editor American Machinist:

We note in your issues of Oct. 22, and Nov. 5, two short articles on the subject of "Hot Air Heating and Ventilating." The matter is one in which we have so long been interested that we are a little surprised to see the opinion expressed that Mr. Walker had made the first application of the system. We are happy to learn that Mr. Snell is to present a paper upon the matter before the A. S. M. E., for his early experience fifteen and twenty years ago was in this identical line in connection with this house.

Since that time many manufactories have been heated and ventilated upon this plan, which can certainly claim superiority in the matter of economy. For, owing to large amount of air brought in contact with the heating surfaces by means of the fan, the amount of steam pipe required in the heater is only one-third to one-fourth that required for direct radiation. Furthermore, the expense of steam piping an entire mill is avoided, the ventilation and heating are combined in one system, and the air being the heating medium the entire system acts rapidly and efficiently.

The Western Penitentiary of Pennsylvania and the portion of Harrison's sugar refinery to which Mr. Le Van refers are both heated and ventilated by apparatus furnished by this house. In fact, its largest business in this line during the past few years has been in connection with mills and shops.

One of the largest plants recently fitted out in this way is that of the shops of the P. C. & St. L. R. W., and C. St. L. & P. R. R. at Columbus, Ohio. This is located similarly to that described by Mr. Walker, but is fitted with a separate apparatus and independent engine in each building, less loss being entailed by the passage of the steam than of the heated air. The independent apparatus allows of direct and rapid control.

The Morgan Engineering Works of Alliance, Ohio, the Otis Iron and Steel Co., of Columbus, Ohio, the Mattoon M'f'g Co., at Sheboygan, Wis., and many other places throughout the country have been furnished with the apparatus and the system designed by us.

B. F. Sturtevant.

It appears, after all, that practical knowledge is gained in building racing yachts. As an example, it is said the designer of the *Volunteer* is engaged on the designs of several sailing vessels for commercial purposes.

LETTERS FROM PRACTICAL MEN.

Tests of Iron.

Editor American Machinist:

Since my article on cupolas I have received letters from foundrymen, asking me for the names of the iron used in getting such strong castings. For the benefit of your readers, I will give the result of several tests taken at our foundry recently.

KIND OF IRON.	TEST.	KIND OF IRON.	TEST.
1.		8.	
½ Minneapolis....	No. 1 1150	½ Minneapolis....	No. 1 1325
½ No. 1 Rockwood.	No. 2 1190	½ Ohio Alice.....	
½ Machine scrap..		½ Machine scrap and stove scrap	No. 2 1500
2.		9.	
½ Minneapolis....	No. 1 1320	1-6 No. 1 Shelby...	No. 1 1225
½ No. 2 Rockwood.	No. 2 1395	1-6 No. 1 National.	
½ Machine scrap..		½ No. 1 Ohio Alice	No. 2 1540
3.		½ Machine scrap and plate.....	
½ Minneapolis...	No. 1 1265	10.	
½ No. 2 Rockwood.	No. 2 1460	½ National.....	No. 1 1375
½ Machine scrap..		1-6 Ohio Alice.....	No. 2 1425
4.		1-6 No. 1 Shelby...	
¼ Minneapolis....	No. 1 1385	½ Mixed scrap ...	
¼ No. 2 Appleton.	No. 2 1380	11.	
¼ No. 1 Rockwood.		1-6 No. 1 Rockwood	No. 1 1575
¼ Machine scrap..		1 6 No. 1 Ohio Alice	No. 2 1650
5.		1-6 No. 2 National.	
½ National	No. 1 1480	1-6 No. 1 Appleton.	
½ No. 1 Rockwood.	No. 2 1550	½ Mixed scrap...	
½ Machine scrap..		12.	
6.		No. 1 Appleton alone.....	No. 1 1305
¼ No. 2 Appleton	No. 1 1340	13.	
¼ No. 1 Rockwood.	No. 2 1550	Minneapolis alone.....	No. 1 1270
¼ Minneapolis....		14.	
¼ Machine scrap..		No. 1 Shelby alone.....	No. 1 1275
7.		15.	
½ No. 1 National..	No. 1 1545	No. 2 Shelby alone.....	No. 1 1345
½ No. 1 Ohio Alice.	No. 2 1640		
½ Machine and stove scrap....			

The test bar was 24 inches long and one inch square. For tests Nos. 12, 13, 14 and 15 the iron was melted in a crucible, so as to be able to get at the real strength of the iron.

The test No. 11 is the one that has given the best result of a mixture, and I am now using that mixture for our season's work. It is strong, and also soft, so that the smallest casting can be drilled.

The Rockwood is a Southern soft iron. The Ohio Alice is a good, strong soft iron. The National is a Lake Superior, hard, strong iron; so is the Appleton. The Minneapolis is from near Minneapolis. The Shelby is a Southern iron.

In my experience I have found that the best results come from mixing different grades of iron together. But any person wanting a nice clean iron, and soft, the No. 1 Rockwood is the best I ever have used. The Shelby is also a clean iron. Any one wanting a good soft iron, and also strong, the Ohio Alice is a good iron. Now, I do not give this in the interest of any iron company, because I am not acquainted with any of the men representing any of those companies. But I give it for the benefit of foundrymen who do not have the same chance of testing as I have. Mr. Masters and myself seem to be the only ones that keep a record of our iron, and give it for the benefit of others.

The Nos. 1 and 2 under test were, No. 1 the first taken from cupola, No. 2 the last.

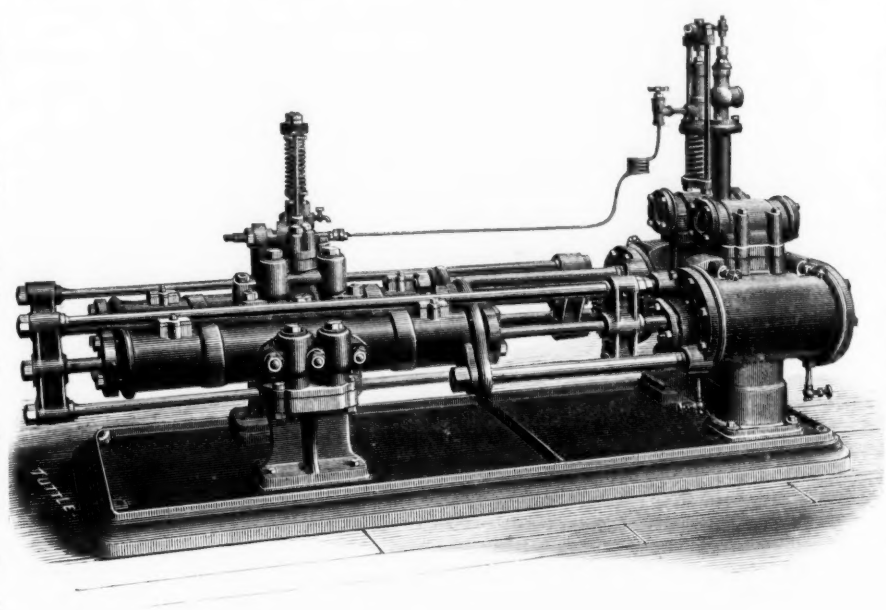
In reply to a question which has just reached me I will say I refer in the above table to transverse strength, the distance between supports being 24 inches.

DAVID SPENCE.

They do things on a large scale "out West." As an evidence, they are to build a dam in Arizona by which it is said a reservoir holding 15,000,000,000 gallons of water will be formed.

Hall Duplex Pump.

In a former issue we illustrated another form of this pump, with a sectional view showing the arrangement of the pistons and valves. It is duplex, the piston of one steam cylinder uncovering ports near the end of its stroke which admit a small quantity of steam to move the valve of the other side. The form which we illustrate herewith is designed for use against heavy water pressures and for severe duty generally. The rods shown outside the water cylinders serve to connect the two plungers which work through stuffing boxes at each end. The plungers and piston rods are of steel. The valves are also of steel. On top of the water cylinder is seen a device which, when the water pressure rises above a certain predetermined point, communicates pressure by means of the small pipe shown, to the governor on the steam end, this governor controlling the supply of steam and regulating the speed of the pump to meet changes of pressure in the water column. They are made by the Hall Steam Pump Company, 91 Liberty street, New York.

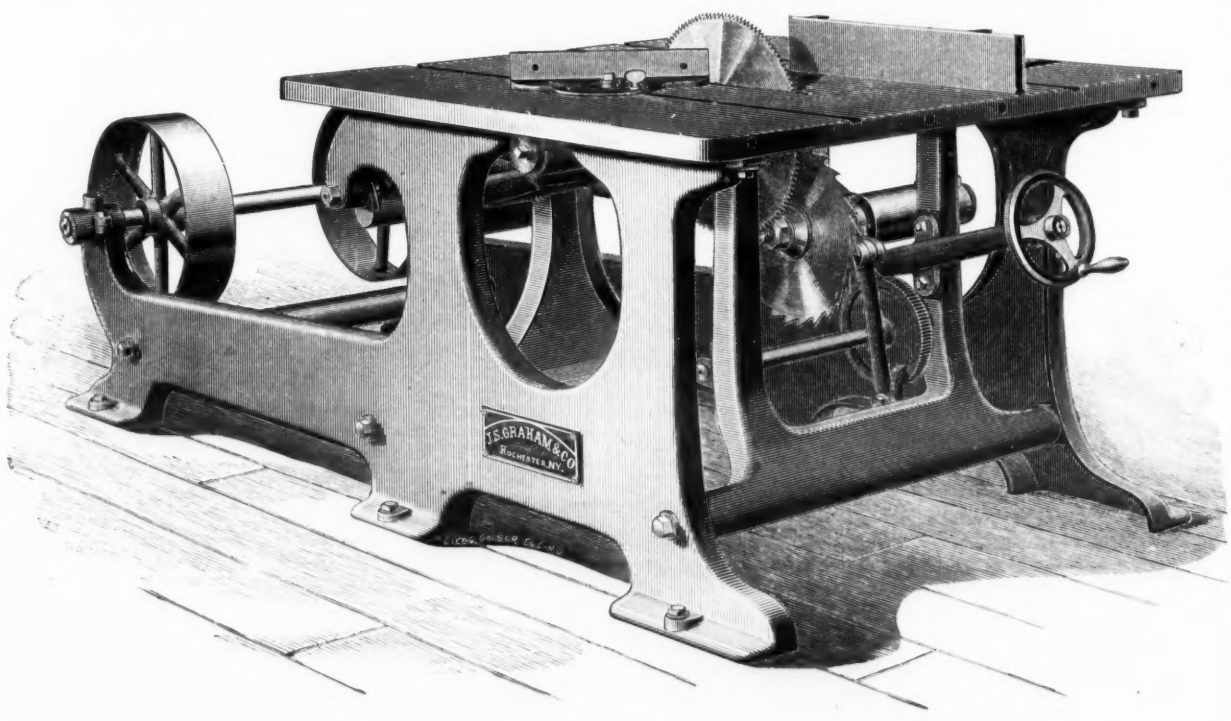


HALL DUPLEX PUMP.

Double Saw Table.

With this is illustrated a new design of saw table, by J. S. Graham & Co., of Rochester, N. Y. Reference to the cut will show that the frame is of a heavy and substantial form, and of sufficient length to carry the countershaft from which the saw arbors are driven. There are two of these arbors, each being driven by its own belt, and either one being brought up to any desired height and sustained in that position, without clamps or other fastenings, by a worm and worm-wheel, operated by the band wheel shown in front and beneath the table.

The table is planed true and grooved on its face for the reception of various devices for facilitating the manipulation of work. One of these is a cross-cut or miter gauge, shown at the left of the saw, and there is also an improved ripping and beveling gauge which is provided with an index for ripping to widths, and also a quadrant laid out in degrees, enabling the operator to set the cross-cut gauge at any angle without the use of extra tools. An improved slitting gauge is provided, which is adjustable to width, can be locked in place readily, and is provided with means for setting at any bevel. It also has an attachment by which the gauge may be set either for tight or slack sawing—a feature which operators will appreciate when they have to change from fine cabinet work to green, wet or icy lumber. The ripping arbor is arranged to receive a dado head, wobble saw, etc., the table being provided with a removable piece for this purpose. The table is 44x48 inches, and saws can be used up to 16" diameter.



DOUBLE SAW TABLE.

Around the Shop.

BY RONDAR.

Some years ago, before the American Society of Mechanical Engineers was founded, we had a little mechanical society out here in Syracuse, and I remember one night the subject of discussion was: "The engine lathe and its operation." There is a man in Syracuse who is a wonderful lathe hand. His work at the lathe, like that of Joshua Rose at the vise, is like magic. I will call him George, for he is a very modest man, and might discharge me if I used his name in the AMERICAN MACHINIST.

Professor Sweet, as president of our society, introduced the subject by one of his characteristic speeches, in which he remarked that every machinist in Syracuse supposed himself to be the best lathe man in the city, but all would agree with him that George was second best. I have thought of that remark many times since, and wondered if, when we thought our judgment was a little better than our associates', or our method better, simpler or easier than theirs, we would not do well to ask ourselves who is second man.

In your issue of August 13th, you illustrated and described a machine for grinding lathe and planer tools. It was my good fortune not long since to see this machine at work in the shop of the makers, and I thought as I looked at the elegant tools ground (for they were elegant): "There is not a machinist of my acquaintance who would entirely approve of these shapes. All would assert (and I believe candidly) that they could grind tools by hand on the old grindstone that would beat these; yet I think I could corner them by asking if they knew anyone else who could do so." Anyone who sees this machine at work and carefully examines the work produced will be forced to admit that the machine comes in second best.

Some years ago, when twist drill grinding machines were coming into use, I was in the shop of a machine tool builder. The foreman showed me a machine for grinding twist drills he had recently put in, and remarked: "I never had any trouble grinding drills. In fact, I think I can grind a drill better than that machine; but I was forced to put it in, for so many of my men made regular botches of their twist-drill grinding." Was not this a case of second best? As the twist-drill grinding machine has become a necessity in the best shops, so I think will the lathe-tool grinding machine in the near future. The introduction of such a machine is one of the inevitable steps of progress. It is bound to come. It will meet with opposition and objection, but the time will come when we will wonder how we got along without it so long. By this system of grinding tools the foreman establishes the standard form of tools for the shop. In case a tool is wanted of novel form, it would be the proper thing to have the foreman give an order for it.

The thought that strikes one in connection with this machine, is the effect on the rising generation of mechanics. One is apt to look on such machines as robbing the old mechanic of some of his prestige, and the apprentice of some of his chance to learn. It should be noted in this connection that it is not desirable to learn a thing, or, having learned it, to remember it, if it is to be of no further use, except those things which from their nature are educators or refiners.

There are very few machinists who know how to turn up a piece of shafting or chase a thread with a hand tool; yet I cannot see that any one is the loser by it. Let tool grinding by hand become a lost art if it will. We do not need to concern ourselves about losing an art when we have no further use for it.

I was brought up in the days of tallow dips. Now it is an art to make a tallow dip. I have forgotten how to do it, but if I was the most skilled man in the world I could not get forty-five cents per day for my handicraft. Grinding tools on an old humpety-bump grindstone is not the most attractive job in the world; so if the boss wants to get this new rig, let us make up our minds that we can stand it.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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Railroad Methods That Need Reforming.

The Wabash Western Railroad and the Pullman Car Company can divide between them the responsibility for a flagrant specimen of such methods. The advertised time tables and circulars of the railroad company assured the traveling public that a Pullman sleeping car formed part of the night train from Central Iowa to Kansas City, and tickets were sold to travelers by connecting roads on that assumption. Through travelers who boarded that train at Givin, Iowa, on the night of September 26th last, found there was no Kansas City sleeping car on the train. Having bought their tickets by this route on the strength of this assurance, and made all their arrangements accordingly, such travelers would naturally have no option but to take the train and sit up all night. To delicate women and tired children, perhaps starting on a long journey, or wearied by the fatigues of travel, such an option could not prove very reassuring, and more especially in view of the rather obvious inference that the Kansas City sleeping car may have been that night sent elsewhere, because a public event in another city offered the chance of a more profitable run. A private individual who should pocket his neighbor's money, and then deceive him in such a way, would lay himself open to the charge of obtaining money under false pretenses.

Another railroad abuse that should be reformed is the idea indulged in by some large corporations, that any kind of road bed or rails is good enough for branch lines. If any enterprising individual connected with railway publishing interests should get out a railway map of the country, indicating the physical character of the mileage, and speaking not at all with reference to altitude, but wholly with reference to the comparative smoothness of the surface over which trains run, we have in mind at least one such branch line, belonging to a pretentious "system" of roads, which he may safely set down as varying from rather hilly to decidedly mountainous.

A kindred abuse which finds abundant exemplars all over the country, is the unnecessarily and outrageously slow passenger time indulged in by both local and branch lines. Time is wasted at stations and between stations as if time had no value. It is as true on one line of railroad as another, though perhaps in differing degrees, that time wasted in this way means travel hindered and traffic lessened, and that, too, without compensating advantage.

Still another widely prevalent abuse, and one which is not inducing the public to feel pleasantly toward railroad corporations, is the apparent effort made by many companies to punish the public for the carelessness or crookedness of railroad ticket agents. If a mistake is made in punching or countersigning, or dating a ticket, the fault is with the ticket seller, and not with the traveler who buys it. Even so simple an expedient as requiring the ticket agent to stamp his name on each ticket he sells would enable the issuing company and all connecting companies, while honoring the ticket, to place the responsibility for the error on the man who made it. Being a railroad servant, he is easily accessible for purposes of reprimand, fine or discharge. Instead of that, railroad conductors are instructed or permitted to play the easier game of confiscating the traveler's ticket, under threats of putting him or her off the train. Timid people often submit to such extortion and pay a second time. In a recent comparison of tickets in a sleeping car on a Western railroad, following such an occurrence, five "defective" tickets were found in the hands of passengers. Not one of the five holders could reasonably hope to complete his journey without finding himself somewhere in trouble with a critical conductor, and all for another man's fault.

First cousin to this latter abuse is stamping conditions on "trip tickets," which, in several contingencies that are very liable to happen, may work annoyance and injustice to the traveler without doing railroad companies any good. One of these is compelling the user to personally identify himself at the destination point, when requiring him to write his name on the ticket anywhere on the route, and comparing it with his original signature on the ticket, would be far more effective, if companies deem such identification important. For instance, if a traveler buys a trip to and from a point 1,000 miles distant, and by any accident is unable to make the whole journey, there is no justice in the attempt to confiscate his ticket and require him to pay return fare a second time.

The difficulty is, the railroad business seems to be about the only business in the country in which managers feel obliged to assume at all times a hostile attitude towards their customers. In most other kinds of business the good will of customers is held to be a valuable asset, and in order to secure such good will, good faith and fair treatment on the part of railroad officials are necessary preliminaries.

Don't Invest.

The low rates of interest paid by savings banks naturally enough lead men and women with small sums of money to invest, to look for more profitable use to make of it. And this natural desire is taken advantage of by stock companies with gigantic capital, in anticipation, sold in shares of only a few dollars, to get in their work. Before investing in schemes of this sort it is wise to look at what has been done before in these directions. Who can call to mind an instance where the small investors in such schemes ever got their money back, to say nothing of the excessive interest promised? The fact ought to be plain that when there are opportunities to make money at such rates as those held out there will be capital in abundance, not in sums of two, three or five dollars, but in as large amounts as may be called for. Let those who are inclined to invest their hard-earned savings in this way first think of a company putting in operation the machinery necessary to collect together and work a capital of some millions of dollars in sums of a few dollars, gathered all over the country, and they will be likely to put their money somewhere else.

The daily press of a few years ago would have exposed these schemes for gulling the people; at the present time, with a few honorable exceptions, it helps them along by accepting their flaming advertisements, and what is much worse in effect, by the seductive but irresponsible "reading notice." It is a lamentable fall in daily journalism, from the time when the old-fashioned journalist considered it part of the duty of a great daily newspaper to use its exceptional advantages for getting information to protect the public, down to the condition where its influence is used to victimize working people in sums of five dollars.

We advise everybody who works hard for his or her money to think twice before investing in a three or five dollar share in a great stock company about which nothing is known except through a page advertisement in the daily press and the concomitant "reading notice."

Unhonored Heroes.

That thousands of men in this world are fitted for positions they will never be called upon to fill goes without saying, but granting this, we cannot see the logic of the argument that such men are less happy than if they were barely suited, by education and otherwise, to fill the places they occupy. We admit the fallacy of the argument that men will always drift into places they are competent to fill; some will do so, but more will not. The great majority of workers must work in subordinate situations, and this would not be different if all were equal in every respect. It may be admitted that it is not entirely pleasant or satisfactory for a man always to be led when he knows he is competent to lead; but such a man will get more enjoyment from life, if he possess the requisite knowledge to be at the head, though he never gets there. The old idea, that a man should get knowledge for its sake alone, although in the main pure nonsense, has yet a good-sized germ of truth in it, which is that there are more uses for knowledge than to make money from, or fill exalted positions with.

There are two good reasons why a workman in any line should strive for knowledge beyond his present needs. One is, that he cannot hope to materially better his condition without doing so. And granting that this hope may not be a certainty, the probability is worth trying for. Wisdom has not yet come to be an attribute so universal, that a man with good sound practical knowledge will not generally find some use for it, even if it is not so great use as he may expect or deserve. The other reason is the satisfaction that a rational mind finds in knowing for the sake of knowing. The argument that in every instance a man will find the place he is qualified to fill is fallacious and mischievous. The argument that the great majority of men will be better for working along in comparative ignorance of things outside their daily labor is infinitely worse, because it ties a man down without hope of progress.

Some of our contemporaries are inclined to take a gloomy view of the final effects of the establishment of gigantic trusts, which appears to be the order of the day. It is true that these many-headed monopolies are mainly formed to control the cost of those things that are classed as necessities, and it is equally true that their effect is costly to consumers, as well as disastrous to small dealers and manufacturers, whom they crush without compunctions of conscience. But they are going at a rate that insures their speedy collapse. Very soon, at their present progress, the people will come to the conclusion that they must be put out of the road of the general prosperity of the country, and a way to do this will be speedily found. The more aggressive and unbearable these trusts become, the sooner will be the day of reckoning, hence we do not "view with alarm" their rapid progress.

As cold weather approaches it is pleasing to observe that the prospects for trade in machinery lines this winter are fairly good. In some branches of the trade, notably in the better classes of steam engines, builders are very busy, with no apparent signs of slacking off. The majority of machine tool builders are also busy, though perhaps there are rather more exceptions here than in the instance of the steam engine trade. There are no indications of any general rush in machine business, but the evidence is all in favor of a very good winter, which means that few mechanics in that line will be idle.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(459) W. R. S., Meridian, Miss., asks: Which is the most responsible trade in the mechanical profession? I claim boiler making is. *A.*—The best we can do in the way of an answer to such a question, will be found in the editorial, "Who Shall be Greatest?" in the issue of Nov. 5.

(460) W. M. F., Toronto, writes: I have a small machine running with a belt. I wish to make the belt produce a positive motion. It is endless, 50" long, 6" wide, running on pulleys exactly 10" in circumference. One of the pulleys is hung upon springs. The belt creeps; so that it don't come around twice alike, which it is very necessary it should do. What shall I do? *A.*—We think you will have to adopt some other method of driving. We know of no way of preventing the creeping of belts.

(461) J. P. P., Hartford, Conn., asks: Can you tell me of a cement that shall be airtight and insoluble in alcohol? I wish to seal up glass tubes with it containing alcohol. *A.*—Try a cement composed of very finely ground litharge

and concentrated glycerine, and merely paint this cement around the stopper. It quickly dries and becomes extremely hard, but can be easily scraped off with a knife when it is necessary to open the glass tubes.

(462) Reader, Bellefont, Pa., asks: Can power be gained with ut the loss of speed, and if such a machine could be invented would it be of any account? *A.*—Power, strictly speaking, can neither be gained nor lost by any machine, except by the action of friction. You evidently mean to say force instead of power, and no machine can be made which will gain force without corresponding loss of speed.

(463) J. W., Brooklyn, N. Y., asks: Will you please inform me what number of feet of heating surface is required for a horizontal tubular boiler, and also for an upright boiler? *A.*—It is good practice to give 15 square feet for each horse-power to be developed in horizontal as well as upright b ilers, both having a natural draft. Some builders allow only 10 and others 12 square feet of heating surface for every horse-power.

(464) E. T. S , Haydenville, Mass., asks: What degree of heat should be the melting point for the filling of fusible or safety plugs for steam boilers? *A.*—The degree of heat for the melting point of fusible plugs should be a little higher than the heat of the steam corresponding to its pressure in the boiler. From this, it appears that for low pressure of steam the degree of heat for melting the plugs can be lower than that used for higher steam pressure.

(465) H. P. A , Phœnixville, Pa., writes: 1. Will you kindly tell me to whom I must apply in order to learn what are the requirements for admission to the Bureau of Steam Engineering, U. S. N? *A.*—Write to Geo. W. Melville, Chief of the Bureau of Construction and Repairs, Washington, D. C. 2. Is there a preference shown for graduates of Annapolis over those of other engineering colleges? *A.*—Yes. 3. Are there any requirements beyond a knowledge of drawing needed for admission to the drafting room in the various navy yards? *A.*—Yes, plenty of political influence.

(466) C. O., Cincinnati, writes: I am building a trial machine to perfect a new invention. In this machine there is a shaft making 1,200 revolutions, from which I wish to drive a train of rollers making 30 revolutions. The work of the rolls is very light, a man being able to turn them with a crank. It is impossible to use belts as they will be too much in the way. The idea is to get the machine as light and compact as possible. Can the driving be done by a worm and wheel? And will a worm work successfully at such a speed. *A.*—We think that with a properly designed worm and wheel there will be no trouble, under the conditions named.

(467) H. A. L., Philadelphia, asks: Can you give me some simple receipt for blackening sheet zinc so it will not easily rub off? I wish to lay out with scratch-awl and dividers, distances, patterns, etc. I have seen small pieces of zinc in use for this purpose, in one shop, but all I could learn was, that they used some solution of acids. The zinc had the appearance of being smoked, but the black did not rub off. *A.*—The most convenient way, perhaps, would be to wet the zinc with water and rub over its surface a piece of "blue-stone," which will have the effect you desire. This "blue stone" dissolved in a bottle of water is probably the "solution of acids" referred to.

(468) Inquirer, Syracuse, N. Y., writes: 1. Please give me the temperature that gives the light straw color, also the blue color in drawing the temper of hardened steel. *A.*—Prof. Thurston in his *Materials of Engineering*, gives these temperatures as 428° and 563° Fahr. respectively. 2. Please inform me where a treatise on superheated steam can be obtained. *A.*—We know of no such treatise, but you will find something upon the subject in most of the works on the subject of steam engineering. 3. What is the weight of a cubic foot of steam at 500° Fahr. or 600° Fahr? *A.*—According to Nystrom's *Steam Engineering*, the weight of a cubic foot of steam at a temperature of 501.8° Fahr. is given at 1.5977 lbs. Its pressure at this point is 7:0 lbs. per square inch. At 531 6° the weight is given at 2 0986 lbs. and pressure 1,000 lbs per inch. 4. Can such temperatures be obtained with a pressure of only 120 lbs.? *A.*—No.

(469) C. W. F., Decatur, Ill., writes: My engine cylinder is 16" x 28", but the stroke is only 24"; makes 85 revolutions per minute. Outside lap of slide valve, ¾ of an inch; inside lap, 7-16 of an inch; steam ports, 1 1-16" x 12"; bridge, 1"; exhaust port, 2 5 16 x 12"; exhaust cavity in slide valve, 3¼ wide; travel, 3 9-16". I intend to back up cylinder heads so as to reduce clearance to about ¼ of an inch at each end of cylinder Therefore, 1. For the best economy of steam to what extent do you advise me to reduce the clearance? *A.*—To answer your question correctly we should know the length of the steam passages, but if these are like the average run of steam passages we should advise you to reduce the clearance to ¼ of an inch. 2 How much will I have to chip out the exhaust cavity? *A.*—According to the dimensions given, you have now an inside lap of 17-32 of an inch instead of 7 16; if you mean that you want an inside lap of 7-16 of an inch, then chip out an equal amount on each side of the exhaust cavity in the valve, so that the cavity will be 3 7-16 inches wide instead of 3¼ inches. 3. What change will the slide valve need? *A.*—If the valve has given satisfaction before, then an alteration of the slide valve will not be necessary. Your letter seems to have been written hastily, and therefore we have some doubt in the correctness of your dimensions. For instance, you say the cylinder is 16" x 28", but the stroke is only 24 inches. Now what do you mean by 28"? Is that the distance between the cylinder heads, or is it the distance through which the piston can travel? If the former, it would seem to us that the clearance would be so small that it cannot be reduced.

(470) Reader, Mass., writes: In the shop where I work we have a horizontal engine, cylinder 15 inches in diameter and 42 inches stroke, slide valve with valves to regulate the cut-off placed on the outside of main valve. The engine was repaired last winter, ports faced and valves planed down, and valve seat faced with steel. The man made a good job, but when starting to run the valves made a loud jarring noise as if sucking up. Regulating the pressure at the throttle would stop the noise in part; but as soon as the load increased the noise commenced. After a few weeks we took the cover off, and found that the valve and seat had been wearing well, but brightest where connected with rod (loose joint). Put on springs to hold the valve to ports. This cured the noise in a great measure. After three months run shows too much wear, and then taking off the springs the noise again commenced. Is this because one face is cast-iron and one of steel? Or is it the valve (52" long) is so far from the connection of rod that the rear end lifts off from the seat, thus throwing bearing of valve on forward end, so imparting a tremble to the rear This might give the jarring noise, as the web connecting the ends of the valve is quite light when the length is considered. If in your judgment our trouble is due to either cause, please state which; or can you think of any other reason? *A.*—The noise is not caused by using a cast-iron valve on a steel valve seat; but it may be caused by several other conditions. From the incomplete description which you have given, it is impossible for any one to locate the trouble without seeing the engine. It is quite possible that the web between the valves proper is too weak and may be the cause of the noise; the design of the cut-off valve may have something to do with it. As far as we can judge from your description, we should say that the cause of the noise is an unequal pressure in the cylinder and steam chest; that is to say, the pressure in the cylinder is sometimes greater than that in the steam chest, and may be caused by water in the cylinder; therefore we would suggest putting a relief valve in the cylinder head or end of cylinder.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Adv., page 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Exhaust Tumbl'g Bbls. Henderson B's., Waterb'y, Ct.

Buy the Excel. Upright Drill; sizes 20", 25", 28", 32", 36" swing. Currier & Snyder Worcester, Mass.

For Improved Cooper Stoves, send to Variety Machine Co., Warsaw, N. Y.

For Electric Recording Steam Gauge, write Telemeter Co., 44 Barclay st., New York.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

For Catalogue of 2d hand lathes, planers, etc., write to John Steptoe & Co., Cincinnati, O.

For the best and cheapest four-horse engines, address Peter Walrath, Chittenango, N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N.Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

If you want the best machine shop or boiler-maker's pencils send to F. A. Rich, 23 South Canal street, Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 133 Jackson st., Chicago, Ill.

Ten 16 in. Engine Lathes, ten 18 in. Eng. Lathes, ten 14 in. Eng. Lathes, ten 15 in. Engine Lathes. Nicholson & Waterman, Providence, R. I.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Nov. 5, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Brown & Sharpe Mfg. Co. have placed at No. 23 South Canal st., Chicago, Ill., a sample line of milling machines and other machinery with S. A. Smith.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES.

T. H. Sampson will build a furniture factory at or near New Orleans, La.

J. M. Huff is interested in building a stove foundry at Ashland, Ky.

Payne & Willingham are interested in building car works at Enterprise, Ga.

Waggoner & Wallace are building a saw mill and a grist mill at McCalla, Ala.

M. P. Moody is trying to organize a hub and spoke company at Jackson, S. C.

W. D. Bradt, of Jackson, Mich., contemplates building a paper mill at some point in Texas.

A company known as the Canton Steam Pump Company has been organized at Canton, Ohio.

Daniel Miller & Company, of Baltimore, Md., propose to build a shirt factory at Mechanicstown, Md.

The large steam ginnery of H. P. Fournet, at Gretna, La., recently destroyed by fire, will be rebuilt.

The Elm City Iron Works, Marion, S. C., have increased their capital stock, and will double their capacity.

John Monigan, 65 South Canal street, Chicago, Ill., is bringing out a new hoisting engine for building purposes.

A company known as the De Funiak Springs (Fla.) Woolen and Cotton Manufacturing Company has been organized.

E. A. Delano, Chicago, Ill., has issued an illustrated price list and circular of pulleys, shafting, hangers and small cranes.

The Spartanburg (S. C.) Water Works Company has been chartered. Elwin A. Bursingame, of Providence, R. I., is interested.

The Decatur (Ala.) Land and Improvement Company is interested in erecting a building in which to furnish shop room for small manufacturers.

J. H. Williams & Co., Brooklyn, N. Y., send us a catalogue illustrating and describing some of the drop forgings, iron and steel, made at their works.

The Campbell Press and Manufacturing Company, New York and Chicago, have issued a sheet illustrating and describing their two-revolution pony press.

The Humphrey Machine Company, Keene, N. H., has purchased the Ellis foundry, together with adjacent lots, upon which they will build a brick machine shop 50 x 100 feet.

E. P. Hampson & Co., 36 Cortlandt street, New York, send us an illustrated circular of the Eclipse Corliss engine. The circular is well illustrated, and the descriptive matter is comprehensive.

W. L. Cheney, Hartford, Conn., has brought out a toy sewing machine for little girls. It operates by hand-crank, and the specimen of work accompanying blue print of machine is very good indeed.

Keuffel & Esser, 127 Fulton street, New York, have issued a small edition of their illustrated catalogue of drawing materials, drawing instruments and surveying instruments. It is very complete in all particulars.

George R. Lombard & Co. are enlarging their foundry, machine and boiler works at Augusta, Ga., by an addition 70 x 200 feet and one 50 x 150 feet, and are erecting a two story building, 30 x 60 x 70 feet, for storage purposes.

The Stanley Rule and Level Company, New Britain, Conn., have put on the market a little device arranged to be quickly clamped to a bit or drill, and provided with a level by observing which the operator can keep the bit or drill perpendicular to the work.

The Waterhouse Electric Company, lately reported as to be chartered at Baltimore, Me., has a capital stock of $250,000. The directors are Robert R. Zell, of New York; William R. Pope, Frank G. Waterhouse, Albert L Gorter, Henry S. Zell and others.—*Manufacturers Record.*

John W. Sewall, Arnold Road, Bow, London, England, has issued a pamphlet descriptive of a large variety of cutting tools made by him. In addition to a description of the tools he makes, the pamphlet contains valuable information on the principles involved in cutting metals.

Business men at Benton Harbor, Mich., propose, if official sanction can be gained, to build a large and substantial dam across Paw Paw river. This may overflow much bottom land, but it is expected to back up sufficient water between Benton Harbor and Paw Paw lake to afford splendid and valuable power.

The Southern Installment Manufacturing Company, capital stock $50,000, has been chartered at New Orleans, La., with Ernest Perkins, Elmer E. Perkins, Horace W. Allen, Charles A. Robinson and Samuel L. Berry as directors. Ernest Perkins is president. The company will manufacture silverware.

E. A. Walker, 75 Laurel street, Philadelphia, writes us: Have recently sold and delivered to Jas. Clarkson & Sons (manufacturers of wood-working machinery), Baltimore, Md., one of the combination planers to plane 25" x 96", and to Herring & Co. (safes and locks), N. Y., one of the 20" x 50" planers.

The Hubbard Tinning Company, of Hubbard, O., and Hon. J. W. Russell, of West Middlesex, Pa., have decided to combine their capital and stock, including the tin mill at Hubbard and the foundry at West Middlesex, and operate a large foundry at Hubbard. For this purpose a stock company will be organized and additional buildings will be built to the tin mill at Hubbard.

New water works, or enlargement of existing works are contemplated at Stratford, Conn.; Jacksonville, Ill.; Redding, Cal.; Marblehead, Mass.; Georgetown, Ky.; Altoona, Pa.; Bunker Hill, Ill.; Toronto, Ont.; Newport, R. I.; Grand Rapids, Mich.; Herkimer, N. Y.; Springfield, Ill.; Santa Rosa, Cal.; Jamestown, N. Y.; Wraston, Ont.; Winchendon, Mass., and Ellenville, N. Y.

The Clyde River Paper Company, of West Derby, Vt., has been made a stock company, and are about organizing under the general law. The capital is to be fixed at $150 000. The company now owns the paper mill, the Bragg property just above, the outlets of Echo pond and Seymour lake, with the control of the water in all these natural reservoirs. They expect to increase the product of this mill, and will quite likely build new ones.

The Findlay (Ohio) woolen mills, owned by L. Rambo & Sons, were entirely destroyed by fire a few days since. The building was a four-story structure filled with valuable machinery, stock and manufactured goods, all of which were destroyed. The fire started from an overheated picker in the fourth story, and owing to the lack of water the fire department could do but little in checking the flames. The loss is estimated at $30,000, upon which there was insurance to the amount of $12,000. The mills will be rebuilt at once.

The McPherson (Kansas) *Freeman* says: Arrangements are being perfected by which McPherson is to have a woolen mill. Messrs. Heggelund, Bass and others are negotiating with a Mr. Miller, of Pennsylvania, for the establishing of a woolen mill plant here. The sum of $4 000 in city lots was asked in order to secure the mill, and these enterprising gentlemen assured Mr. Miller that he could have the lots whenever he established the mill, and it is now thought that the deal will be closed in a few days and the plant secured beyond any question.

A. C. Hall, a wealthy inventor of Colorado, has been in the city several days organizing a company of capitalists to build an immense works in this city (Pittsburgh), for the manufacture of wrought-iron carriage wheels under patents owned by Mr. Hall. The organization of the company is almost completed, and it will have a capital of $1,000,000. The company will be incorporated in a few weeks, and is composed chiefly of Pittsburgh capitalists. It is proposed to spend $100.000 in building a plant, which will be on the banks of one of the rivers. The works will give employment to 150 men at the start, which will be increased as the company enlarges the plant.—*American Manufacturer.*

James McMillan and ten other gentlemen have formed a stock company in Detroit to manufacture electric accumulators for storage batteries for light and power purposes. The patent under which the company will work covers inventions by Faure, Plante, Swan, Valckinsar, Beeman, Shaw, Starr, King, Philipont and other eminent electricians. Light, it is claimed, will be stored in packets for delivery anywhere, and power will be contained in small, neat jars, by means of which sewing machines can be run, house elevators operated, etc., etc. It is also expected to use the system to propel street cars, buggies, yachts, and heavy machinery.

Articles of association of the Valley City (Mich.) Knitting Mill Company were filed recently with the county clerk. The purpose of the corporation, as stated in the document, is the manufacture of fine knit goods, seamless hosiery and all other kinds of knit goods, the buying or leasing of any and all real estate machinery needed for the conducting of such business and the selling, at wholesale or retail, of the produce of such manufacture. The capital stock is $10,000 and the number of shares 400. The stockholders in the company are: Anna M. Heller, Virginia E. Heller, Simon J. Heller, Dr. W. H. Ross, Samuel D. Clay, Parley H. Brown, John G. Lee, William H. Eastman and L. E Carroll, of this city. The two former are the principal stockholders.

Machinists' Supplies and Iron.

NEW YORK, Nov. 3, 1887.

Iron—American Pig—There have been no changes of importance in the condition of the market since our last report. Prime Lehigh brands of foundry continue scarce, the deliveries closely absorbing the output and leaving scarcely any surplus for occasional buyers. Standard Lehigh brands of No. 1 X Foundry are firmly held at $21 to $21.50, and in a small way $22 has been paid, but other brands can be bought at $20.50 to $21. We quote No. 2 X Foundry at $19 to $19.50 for good brands down to $18.50 for inferior. Grey Forge is freely offered at $16 50 to $17.25.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Situation wanted as draftsman on light hardware; practical. Address Good Taste, AM. MACHINIST.

Wanted—Two machinists, vise or floor hands. Apply or address Lane's Machine Works, Huntingdon, Pa.

Foundry foreman, 19 years' experience on general machinery, desires to change his present position. Address Box 70, AM. MACHINIST.

Wanted—Position as foundry foreman by a young man, understands getting work out quicky, experienced in green and dry sand work. J. A. S., AM. MACHINIST.

Wanted—A blacksmith, experienced in drop and machine forging, to take charge. Address, stating experience and wages expected, Foreman, Box 64, AM. MACHINIST.

A mechanical draftsman of 25 years' experience in general and special machine design, desires a position; can give best of references. Address Box 71, AM. MACHINIST.

Wanted—Situation as draftsman by a young man, graduate of polytechnic school in Norway, one year's experience; good references. Address H. E. N., 377 Lyceum ave., Roseborough, Pa.

Draftsman wanted. Must have had practical experience in machine design. Address, stating age, experience, reference, and compensation wanted, The Yale & Towne Mfg. Co., Stamford, Ct.

Wanted—Situation by first-class managing superintendent of hard and soft rubber works; skilled in every detail in getting out tools, dies, etc. for blown and pressed work. Address Rubber, AM. MACHINIST.

Wanted—Position as Supt. or Foreman by a young man who has held the same for a number of years on fine tools, interchangeable work and auromatic machinery. Best of references. W. H. S., 1331 So. 16th St., Phila., Pa.

Mechanical draftsman, neat and rapid, well posted on the different kinds of work connected with the drafting room as well as the shop, wants situation, age 28, any part of United States. Address "S.," Box 152, Cleveland, Ohio.

Brass foundry foreman wanted to take charge of a large foundry producing hardware castings of all kinds, including fine ornamental bronze work. Address, stating age, experience, references, and salary expected, Yale & Towne Mfg. Co., Stamford, Ct.

A good draftsman and machinist, used to handling men, and familiar with heavy engine and mill work, now superintendent of large works in above line, wishes to change where ability will command reasonable remuneration. Earnest, AM. MACHINIST.

Wanted—Position as foreman or superintendent; several years' experience in charge of shops employing over 100 men. Specialties heavy tools, engine, and steam pump work, and the designing of special tools for the duplicate production thereof. M. A., care of AM. MACHINIST.

Wanted—Engagement by a first-class M. E. on or before Dec. 1, good draftsman in all branches of mechanics, skilled and accurate in getting out tools and work on the interchangeable system. Pattern foundry and sheet-metal work; capable of managing help. Address Tools, AM. MACHINIST.

Designer and draftsman able to design a new line of machinery desires to make arrangements with parties having facilities for building same; will design and build the first machine at my own expense, and then take the contract for building same, using the company's tools and facilities. Address Star, AM. MACHINIST.

Wanted—Partner with capital to join advertiser to push sales and extend a manufacturing business that is well advertised and known in all parts of the country. The simplicity and merit of the machine is winning success wherever used, and the profits first year have paid all experimental, advertising and manufacturing expenses. Address Business, AM. MACHINIST.

✣ MISCELLANEOUS WANTS. ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Cyclone Steam Flue Cleaner is king, and has no rival. Crescent Mfg. Co., Cleveland, Ohio.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Stationary boat engines, boilers, best, cheapest, 1 to 10 H. P. Washburn Engine Co., Medina, Ohio.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. I. A. Weston & Co., Syracuse, N. Y.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer, late chf. draftsman at H. R. Worthington. Designs and working drawings of water works, pumps, gen. mach. & pat. drawings.

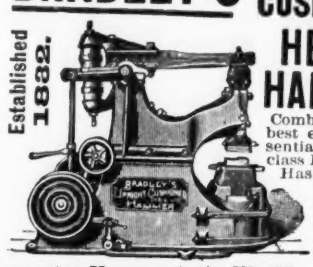
For Sale—One horizontal two flue boiler; diameter of flues, 15 inches; diameter of boiler, 48 inches; length of boiler, 28 feet. In good condition. Apply to The Faby's Watch Case Co., Sag Harbor, Long Island, N. Y.

Machine works with capital and proper location desirousot going into the specialty of building first class elevator work of every kind, will be offered exceptional inducements. Address by letter R. C. Smith, late chief eng. Otis Bros., 138, No. 1 B'way, N. Y.

To Foundrymen and Machinists.—Wanted—A practical man with small capital to purchase whole or part interest in a small machine shop and foundry; object principally to have competent man to run foundry. Address Box 4, Weatherford, Texas, giving experience and amount willing to invest.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

BRADLEY & CO. Syracuse, N.Y.

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832.

For Hard Coal or Coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

BRADLEY & CO. Syracuse, N.Y.

STEPHENS PATENT VISES.

ONE-HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular

TOWER & LYON,
95 Chambers Street, New York.
Successors to MELVIN STEPHENS.

THE BACKUS WATER MOTOR

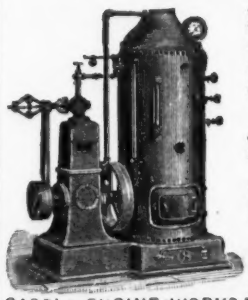
SUPPLIES FROM HYDRANT PRESSURE the cheapest power known. Invaluable for blowing Church Organs, running Printing Presses, Sewing Machines in Households, Turning Lathes, Scroll Saws, Grindstones, Coffee Mills, Sausage Machines, Feed Cutters, Electric Lights, Elevators, etc. It needs little room, no firing up, fuel, ashes, repairs, engineer, explosion, or delay, no extra insurance, no coal bills. Is noiseless, neat, compact, steady; will work at any pressure of water above 15 lb.; at 40 lb. pressure has 4-horse power, and capacity up to 10-horse power. Prices from $15 to $300. Send for circular to

THE BACKUS WATER MOTOR CO., Newark, N. J.

ECONOMICAL STEAM BOILERS A SPECIALTY.

SEND FOR PRICES **Pond Engineering Co.** ST. LOUIS MO.

The Castle Engine.



The Extreme in Simplicity, Durability and freedom from racking. Positive, Noiseless, Self Lubricating and Economical. Many now running.

Solid Comfort for the user.

One and Two Cylinder Engines for Launch and other purposes.

Vertical, Horizontal and Porcupine Boilers, with Supplies. Low Prices. 1 to 15 H. P.

Send for Circular.

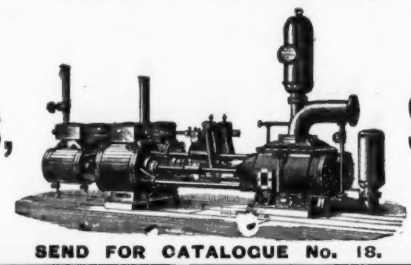
4 H. P. Steel Boiler and 2 H. P. Engine compl., $180.

4 H. P. Steel Boiler and 3 H. P. Engine compl., $216.

CASTLE ENGINE WORKS, Indianapolis, Ind.

THE DEANE STEAM PUMP CO., Holyoke, Mass.

BUILD Water Works, ENGINES



AND Steam Pumping MACHINERY.

SEND FOR CATALOGUE No. 18.

IF YOU WANT A SHAPER, PLANER, DRILL, LATHE OR SPECIAL MACHINERY, WRITE TO THE HENDEY MACHINE CO., SEND FOR A CATALOGUE. TORRINGTON, CONN.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS. JAS. HUNTER & SON, North Adams, Mass.

CRESCENT STEEL WORKS.

CRESCENT STEEL **MILLER, METCALF & PARKIN.**

480 PEARL ST. NEW YORK. PITTSBURGH, PA. 64&66 S. CLINTON ST. CHICAGO

OUR NEW **CATALOGUE OF TOOLS** and Supplies sent free to any address on receipt of Ten Cents in stamps (for postage).

CHAS. A. STRELINGER & CO., Wood Ave., Detroit, Mich.

TANITE For Saw Mills, Foundries and Machine Shops

Emery Wheels and Grinding Machines. For circulars address

THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.

Or H. A. Rogers, 19 John Street, New York.

By the Author of the Moulders' Text-Book.

JOHN WILEY & SONS, 15 Astor Place, N. Y.

PUBLISH

American Foundry Practice,

TREATING OF

Loam, Dry Sand and Green Sand Moulding,

AND CONTAINING

A Practical Treatise upon the Management of Cupolas and the Melting of Iron.

BY THOMAS D. WEST,

PRACTICAL IRON-MOULDER AND FOUNDRY FOREMAN.

Fully Illustrated. 12mo. Cloth. $2.50.

SIXTH EDITION, REVISED, (1887.)

NOTICES.

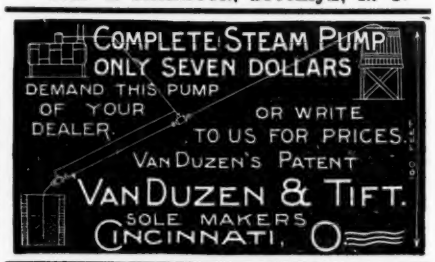
"One hundred items, that *apprentices* should know and remember, alone are worth the price of the whole work. . . . It is not written with a special view to instructing apprentices, but as *a handbook for men who have learned the trade.*"—*American Machinist.*

STEAM PUMPS for Hot or Cold, Fresh or Salt Water; for Oils, Naphtha, Tar; for Cane Juice, Liquors, Syrups, Scum; for Ammonia, Alkalies, Extracts, Acids; for Thick, Volatile, Viscous or Foul Liquids, etc. VACUUM PUMPS of the highest efficiency. FILTER PRESS PUMPS. Air, Gas and Acid Blowers. AIR COMPRESSORS. Etc. BUILT BY

GUILD & GARRISON, Brooklyn, N. Y.

COMPLETE STEAM PUMP ONLY SEVEN DOLLARS

DEMAND THIS PUMP OF YOUR DEALER. OR WRITE TO US FOR PRICES.



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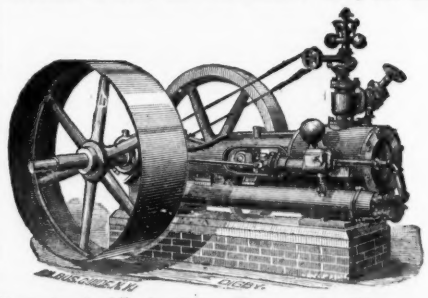

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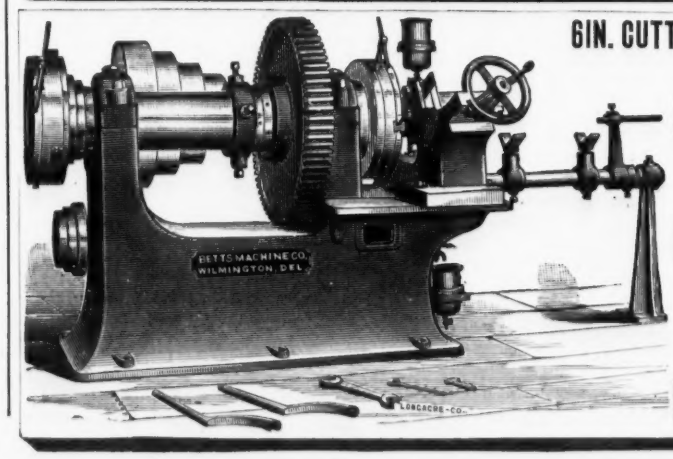

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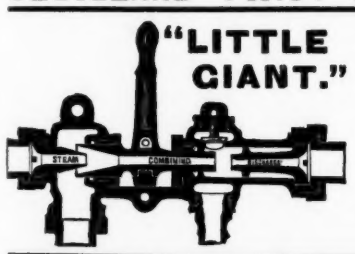

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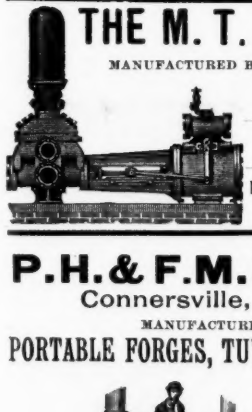

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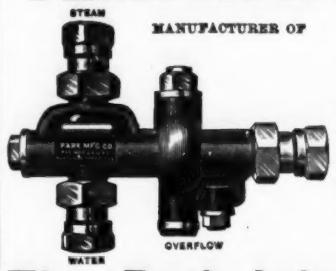

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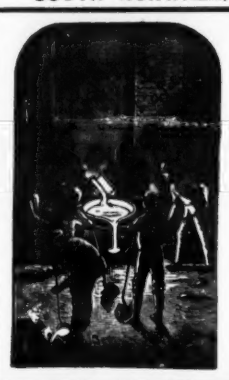

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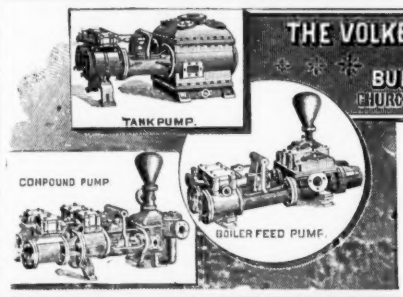

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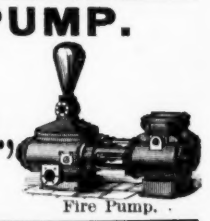

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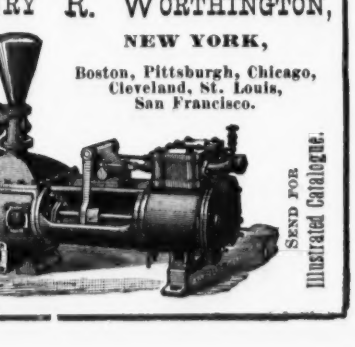

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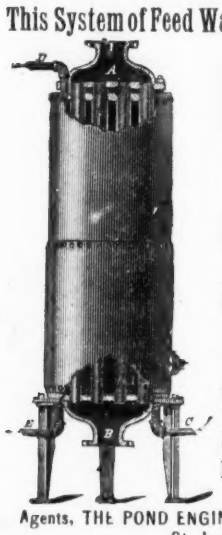

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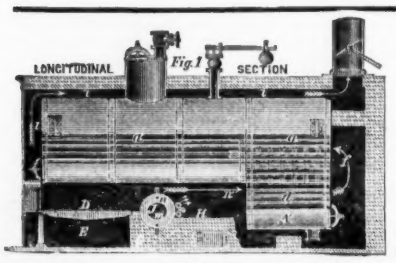

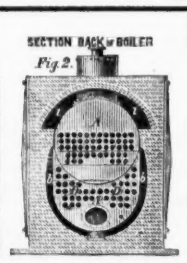

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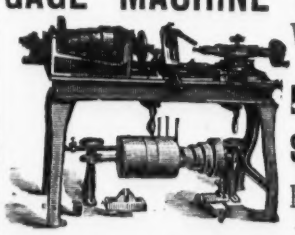

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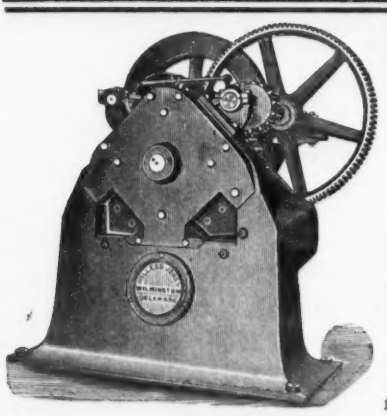

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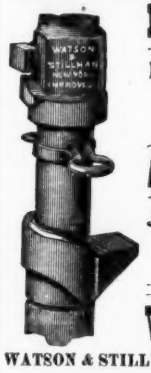

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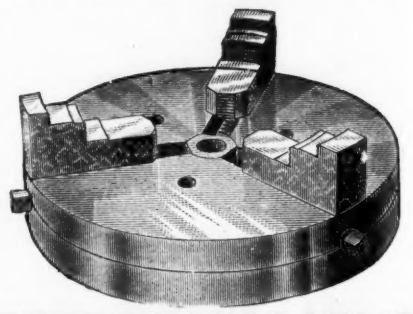

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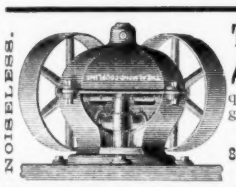

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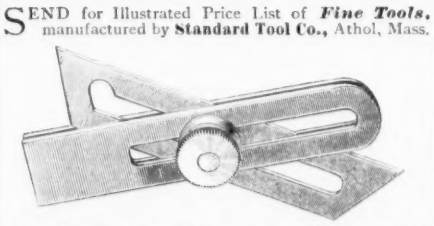

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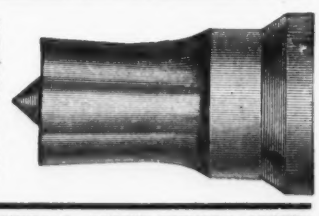

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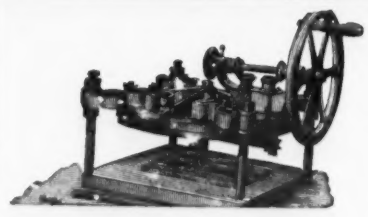
PATENTS

R. G. Du Bois, Patent Att'y, 916 F St., Washington, D. C. Good references. Send for pamphlet.



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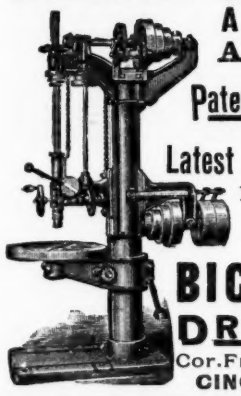

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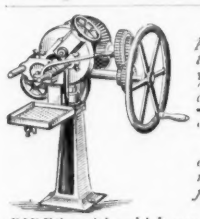

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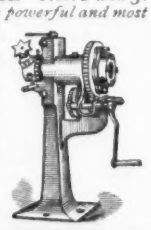

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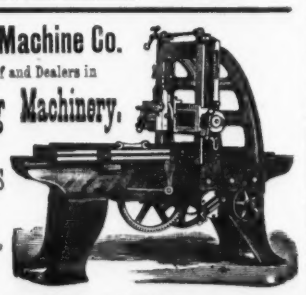

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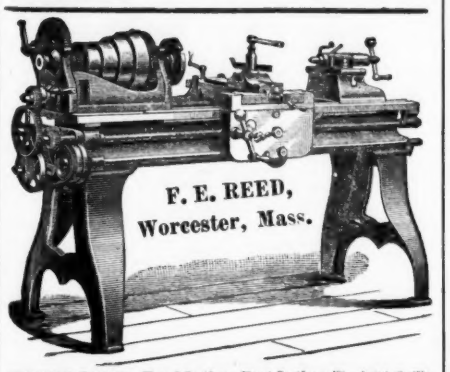

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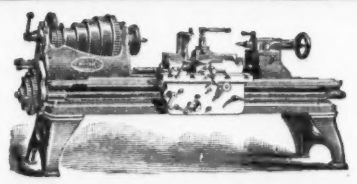

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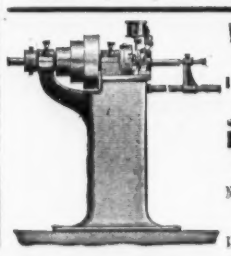

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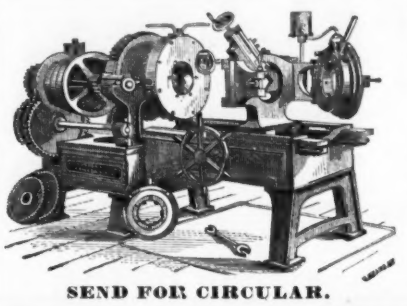

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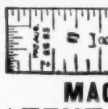

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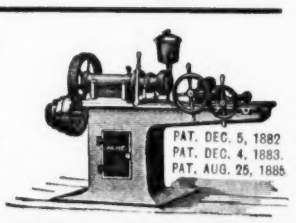

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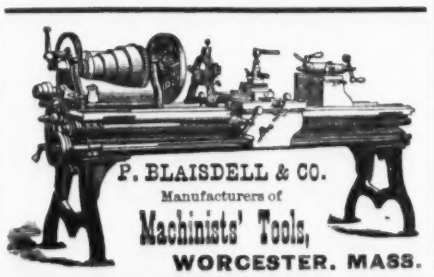

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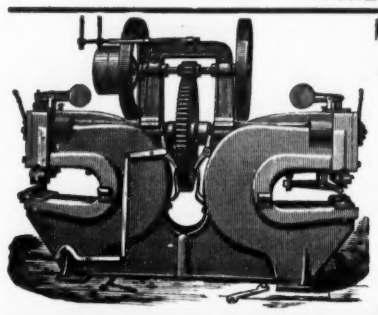

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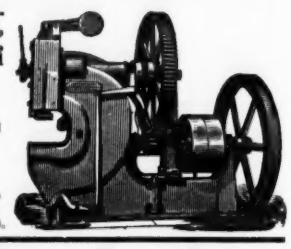

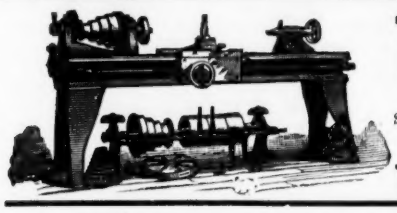

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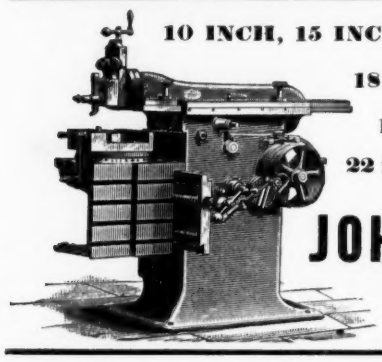

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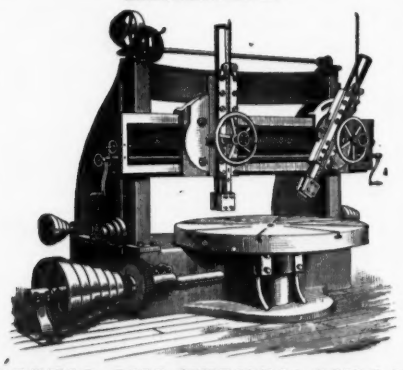

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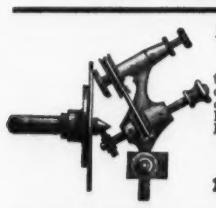

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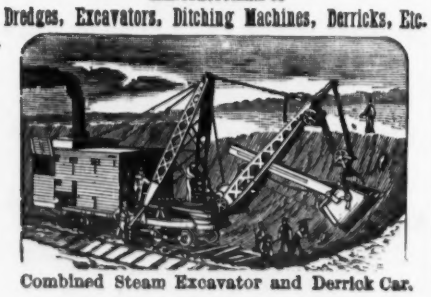

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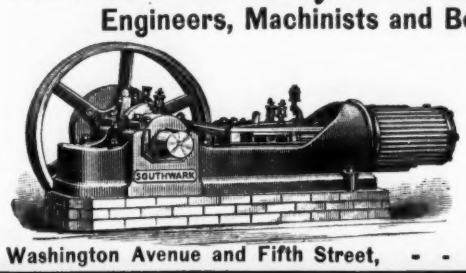

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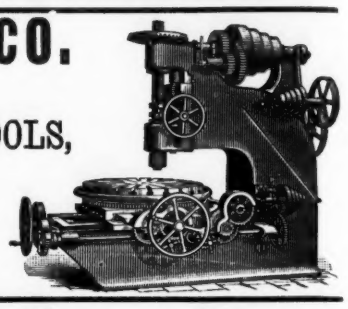

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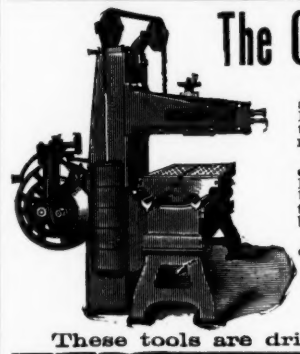

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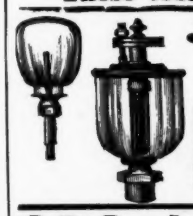

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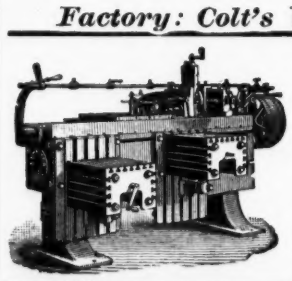

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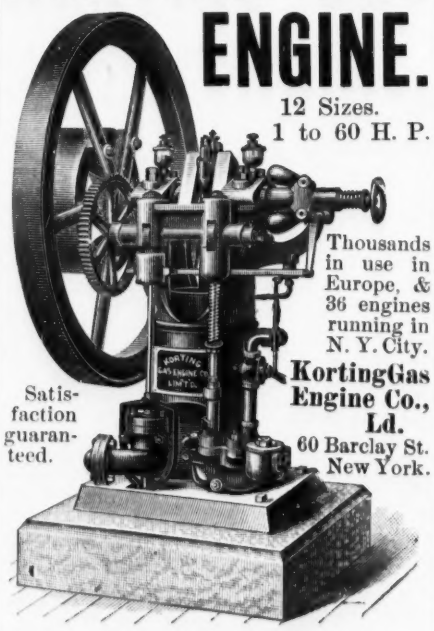

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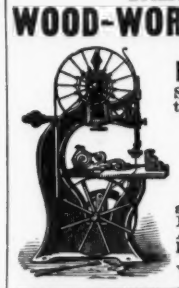

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One	70 H. P. Stationary Boiler	" "
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Two	40 H. P. " "	" "
One	30 H. P. Vertical "	" "
Two	15 H. P. " "	" "
One	40 H. P. Portable Engine	" "
"	30 H. P. " "	" "
"	8 H. P. " "	" "
"	60 H. P. Stationary "	" "
"	20 H. P. " "	" "
"	20 H. P. Vertical "	" "
Two	12 H. P. " "	" "
One	Surface Planer, 27″ wide,	" "
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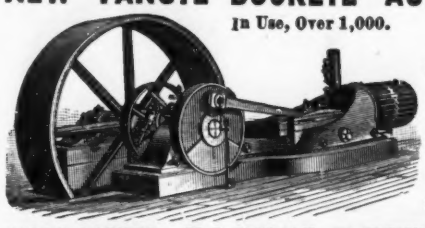

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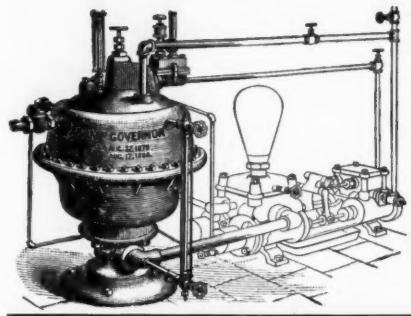

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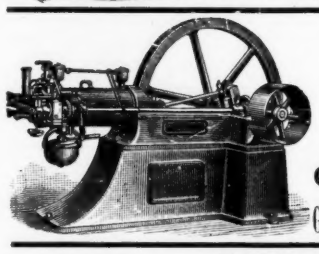

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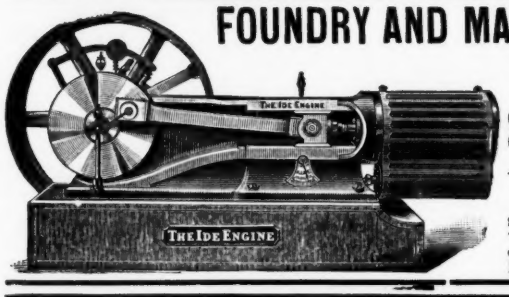

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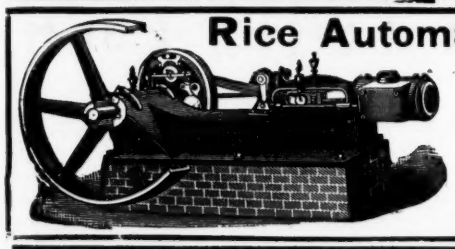

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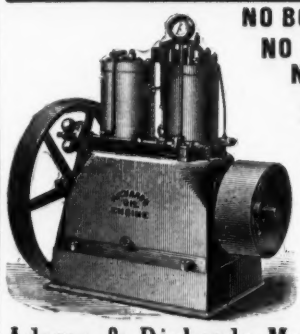

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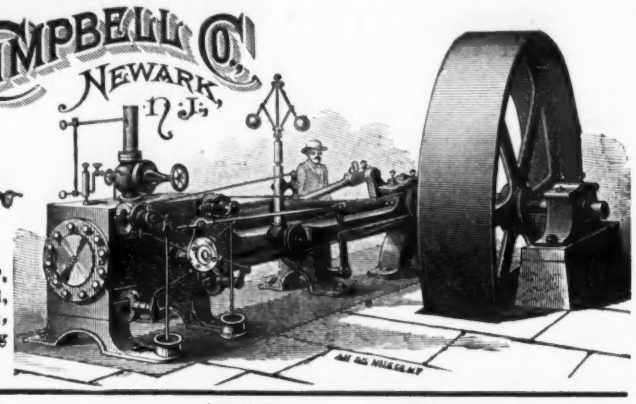

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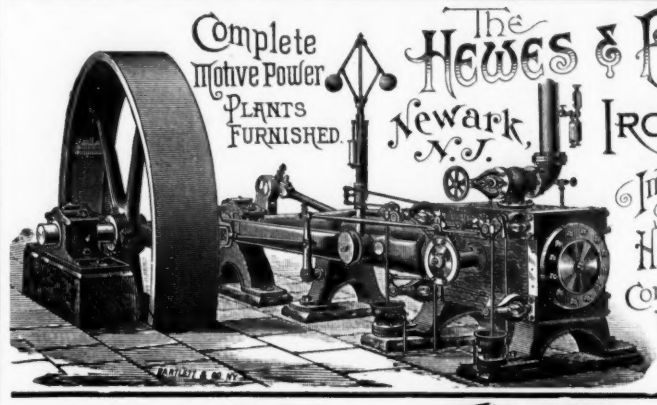

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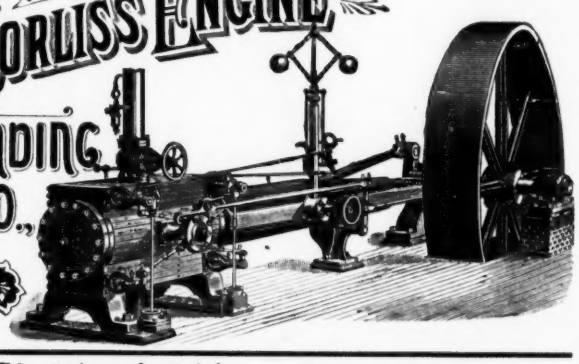

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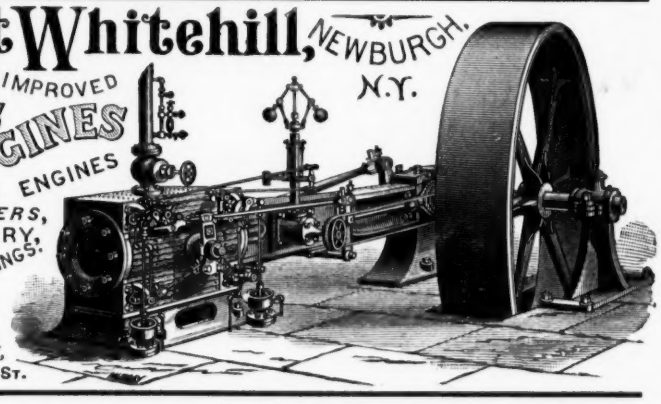

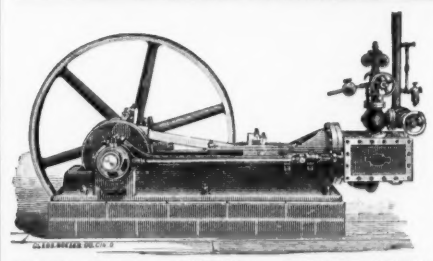

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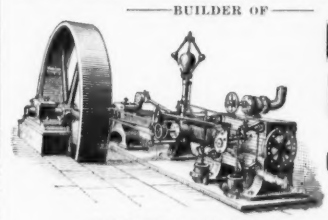

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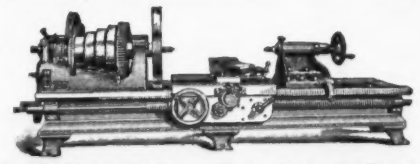

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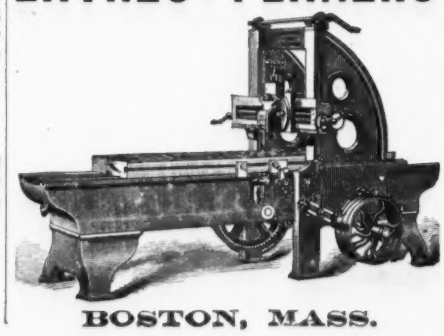

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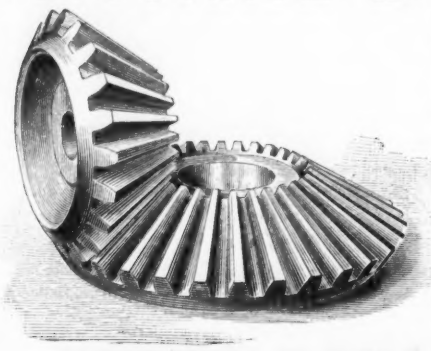

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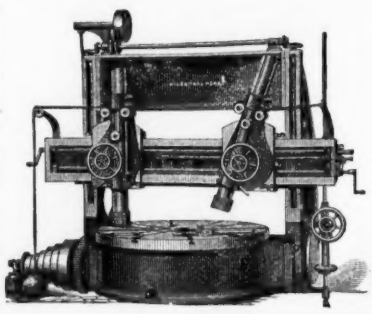

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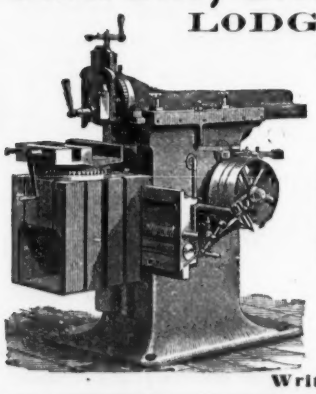

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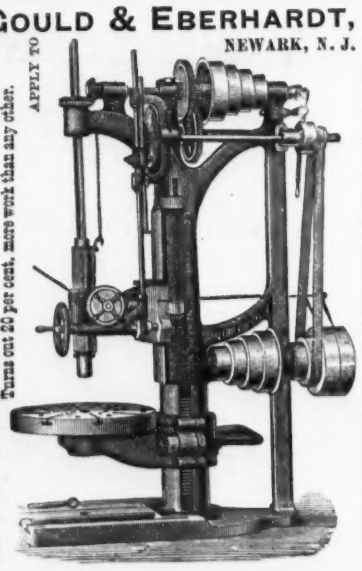

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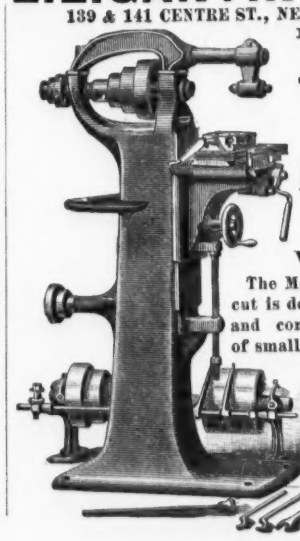

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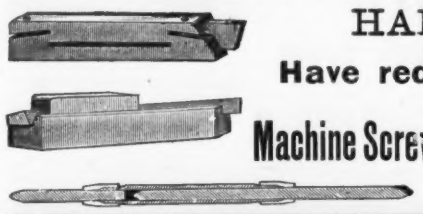

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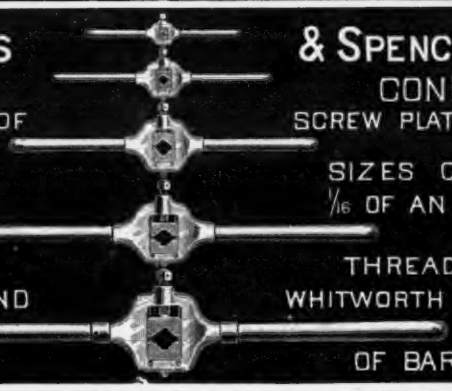

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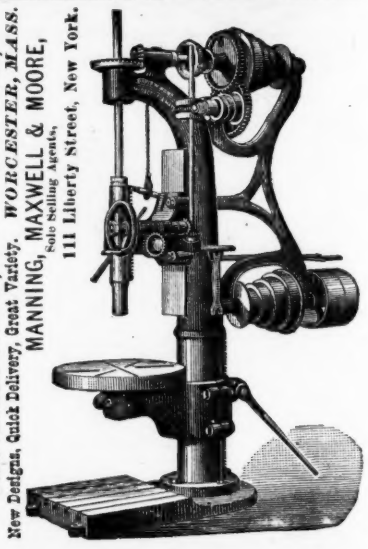

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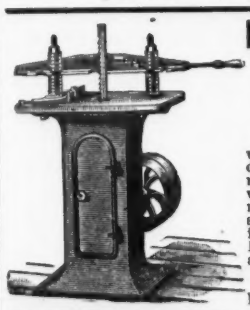

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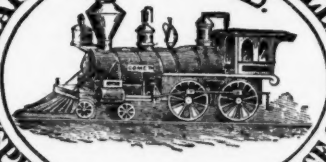

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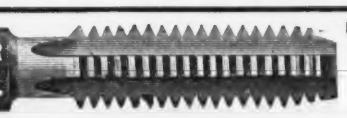

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